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Higher Fossil Faunas of the Upper Allegheny

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PREFACE

The paramount aim of this paper is to bring together, with some completeness, illustrations of the rich fauna of the upper Devonian and lower Carboniferous strata in the northwestern part of Pennsylvania and the southwestern part of New York. Several new forms are described and the majority of the more common species have been carefully studied both from original material and from specimens in the Cornell University Museum.

This work in no way pretends to be a monograph of the region, which is really very poorly explored from a paleontological view point, the many described species notwithstanding. It is hoped that the plates accompanying the paper will afford a ready means of identification both in the field and laboratory, although the original dissertation must frequently be consulted for a detailed description.

The paleontologic and stratigraphic work in this region is only nicely commenced, and much must yet be done before its past history is satisfactorily explained, especially in its relation to that of surrounding regions. Only by most painstaking paleontologic study will the problem of the Carboniferous-Devonian boundaries for this region be solved. One of the real difficulties of casual study of the faunas of this region is the existence of an extreme range of variation in many of the more common species. The determination of both the horizontal and vertical extent of these minor variations would seem to be the next logical step in the progress of our knowledge.

The stratigraphy of this paper is fundamentally based on the work of professors, Hall, Harris, Butts, Glenn, Clarke, Verwiebe, Girty, and Chadwick. The last named is at present carrying on the work, started some years ago, of unravelling and clarifying the stratigraphy of this region. While in some instances the exact named correlate of beds from which fossils have been obtained is not determined in this paper an attempt has been made in all instances to give the exact locality so far as is known, and the probable horizon is intimated. Many of the specimens

described in the early volumes of the Paleontology of New York are called Chemung species when in reality they belong to what we now know as Conewango, Oswayo, or even in some instances, to Mississippian horizons.

The specific description of already described species is usually abridged from the work of the original describer. To this any apparently essential remarks are added. In many instances the illustrations seem to be sufficient characterization for the species.

In a work of this nature it is felt unnecessary to give other than the most essential references under the specific synonymy. It is also felt that elaborate systematic headings are best suited to true monographs and that elsewhere they only encumber the literature.

All original material used in the preparation of this paper is in the paleontological collection of Cornell University. This material is made up of specimens collected by Prof. H. S. Williams, collections of Prof. G. D. Harris, of students at the Cornell Summer School of Geology at Stoneham, Pa., and of the writer.

The writer acknowledges with gratitude the kindness of Dr. Rudolf Ruedemann in examining specimens and permitting him to study many of James Hall's type specimens from the New York State Museum, at Albany, N. Y.

To Professor G. D. Harris, teacher, advisor and friend, the writer is especially grateful for both enthusiastic encouragement and constant suggestions in field and laboratory. It is now through his kindness that this paper is published.

Paleontology Laboratory
Cornell University
JUNE 15, 1929.

BRACHIOPODA

LINGULA

Lingula scutella Hall Plate 10, fig. 25.

Pal. of N. Y. VIII, I, 1892, p. 171, pl. 1, fig. 30.

Occurrence.—In the Chemung group of Alleghany county, N. Y.

Note—In the arenaceous brown shale along the Roosevelt Highway at the northern border of Smethport, Pa., there are many fragments of Lingulas of various sizes. Some of these fragments probably belong to this species.

Lingula cuyahoga Hall Plate 10, figs. 13, 15.

Pal. of N. Y. IV, 1867, p. 12, pl. 2, fig. 9.

Occurrence.—First described from the Waverly sandstone of Ohio and specimens referred to this species with doubt were found by Hall and Clarke in the Panama conglomerate.

Lingula delia Hall Plate 10, fig. 19

Pal. of N. Y. IV, 1867, p. 12, pl. 2, fig. 9.

This is typically a Hamilton *Lingula* but has been reported by Carll and Randall from the Chemung group at Warren, Pa., according to P. Lesley. (Dict. of Fossils, I, p. 344.)

Lingula ligea Hall Plate 10, figs. 14, 16.

Pal. of N. Y. IV, 1867, p. 7, pl. 1, fig. 2.

This, like the preceding species, is characteristic of the Hamilton shales but has been reported by Carll from the "Chemung upper strata."

Lingula waverliensis Herrick Plate 10, fig. 28.

Bull. Dennison Univ. IV, pt. I, 1888, p. 18, pl. III, fig. 1.

This form is especially interesting due to the preservation of the pedicle with the shell. It was found in the "Waverly sandstone" at Oil City, Pa.

LINGULODISCINA

Lingulodiscina pleurites (Meek) Plate 10, figs. 21-23.

Discina (Orbiculoidea?) pleurites Meek, Pal. of Ohio, II, 1875, p. 278, pl. 14, fig. 2.

Occurrence.—Recorded from the Wolf Creek Conglomerate in the Olean region, by Mr. C. Butts. (Bull. N. Y. S. Mus. No. 69, p. 993.)

This species was originally described from the Waverly sandstone of Ohio. It has subsequently been reported from the Bedford shales of Ohio by G. Girty[1] and from the Wolf Creek conglomerate of the Olean quadrangle by C. Butts[2].

ORBICULOIDEA

Orbiculoidea allegania (Hall) Plate 10, figs. 24, 26, 27.

Discina allegania Hall, Pal. of N. Y., IV, 1867, p. 25, fig. 1, pl. 1, fig. 17.

This is a very large species which bears very fine striæ and is marginally flattened. The apex is a little more than one third of the diameter of the shell from the posterior.

Occurrence.—In the Chemung group at Hobbieville, Allegany county, N. Y.

Orbiculoidea Sp.

Fragments of *Orbiculodiea* are the most characteristic feature of small, discontinuous layers of coarse sandy shale in the rocks which are exposed at the northern outskirts of Smethport, Pa., on the Roosevelt Highway. These layers are seldom more than two inches in thickness and none have been observed extending for more than a few feet.

In the Oswayo beds as exposed about two miles west of Smethport, Pa., in a cut along a spur railroad near an abandoned mill, once used for crushing the conglomerate, Orbiculoideas are common. The specimens are all badly crumpled and broken, yet, from these it is evident that the living specimen was very large. The surface is ornamented by very coarse concentric striæ (which are impressed on the mold) spaced about .75 mm. apart. Between these there are many microscopic striæ. Although this species is quite probably undescribed the quality of the material at hand does not warrant a specific description.

CRANIA

Crania leoni Hall — Plate 10, figs. 17, 18, 20, 28, 29.

Pal. of N. Y. vol. IV, 1867, p. 30, pl. 3, figs. 27-30.

Occurrence.—In the Chemung beds at Leon, Cattaraugus county, N. Y. We have also found specimens, temporarily referred to this species, in the Oswayo beds near Olean Rock City, N. Y.

SCHUCHERTELLA

Schuchertella chemungensis (Conrad) — Plate 15, figs. 1-3, 5, 6, 8.

Streptorhynchus chemungensis (Hall) Pal. of N. Y. vol. IV, 1887, p. 67.
Streptorhynchus chemungensis var. **pectinacea** Hall, Pal. of N. Y. vol. IV, 1867, p. 73, pl. 10, fig. 6.

Occurrence.—Originally described by Conrad from material collected at Chemung Narrows. Reported by Ashburner from over the Salamanca Conglomerate and by Lesley, in the Dictionary of Fossils, p. 1090, from the Panama conglomerate. We have also collected specimens of this species well preserved in the Panama conglomerate at Checkered School House, near Ashville, N. Y.

ORTHOTHETES

Orthothetes crenistria (Phillips?) Plate 16, figs. 1, 2.

Hemipronites crenistria, Herrick, Bull. Dennison Univ. vol. IV, 1888, p. 24, pl. 2, figs. 1, 5.

Orthothetes crenistria Hall and Clarke, Pal. of N. Y. vol. VIII, I, 1892, pl. 11a, fig. 15.

Occurrence.—In the Waverly sandstones of Ohio. Reported by Mr. C. Butts from the beds between the Wolf Creek and the Salamanca conglomerates.

[1]Girty, G. H., Ann. N. Y. Acad. Sc. vol. 22, 1912, p. 295.
[2]Butts, C., N. Y. S. Mus. Bull. No. 69, p. 994.

STROPHALOSIA

Strophalosia histricula (Hall) Plate 20, figs 15-20.

Productella histricula Hall, Pal. of N. Y. IV, 1867, p. 178, pl. 26, figs. 1-8.

Occurrence.—According to J. Hall, this species is very common in a hard arenaceous shale at Forestville, N. Y., and in a friable sandstone at Conewango, and in semi-calcareous layers at East Randolph, N. Y. Specimens possibly referable to this species are commonly found in a yellowish sandstone of the Venango First Oil Sand horizon one mile east of Stoneham, Pa.

Strophalosia muricata (Hall) Plate 16, figs. 3-8.

Chonetes muricata Hall, Pal. of N. Y. IV, 1867, p. 143, pl. 22, figs. 29-43.

Occurrence.—In the arenaceous and semi-calcareous beds of the 'Chemung group' at Ellington, Chautauqua county, N. Y., and at Meadville, Pa.

CHONETES

Chonetes lepidus Hall Plate 16, fig. 10.

Pal. of N. Y. IV, 1867, p. 142, pl. 22, figs. 12, 13.

Occurrence.—In the Marcellus shales and in the Chemung beds at Great Valley, Forestville, Chautauqua county, N. Y., and rarely at Meadville, Pa.

Chonetes scitulus Hall Plate 16, figs. 9, 11-13.

Pal. of N. Y. IV, 1867, p. 141, pl. 21, fig. 4.

Occurrence.—In the Portage and lower Chemung shales and in the upper Chemung at Grass Valley and Conewango in Cattaraugus county, N. Y., in Chautauqua county and at Meadville, Pa. This species is reported by Prosser (Geol. Surv. of

Ohio. Bull. 15, p. 97) from the Riceville shales of Ohio and from the Bedford shales of Ohio by Herrick (Am. Geol. III, p. 97.)

Chonetes setigerus (Hall) Plate 16, figs. 14-17.

Pal. of N. Y. IV, 1867, p. 129, pl. 21, fig. 2; pl. 22, figs. 1-5.

Occurrence.—In the Genessee and Marcellus shales and in the Chemung group at Meadville, Pa.

RHIPIDOMELLA

Rhipidomella leucosia (Hall) Plate 16, figs. 19, 22.

Orthis leucosia Hall, Pal. of N. Y. IV, 1867, pp. 48, 63, pl. 7, fig. 4; pl. 8, figs. 9, 10.

Occurrence.—This is characteristically a Hamilton species but forms referred to this species have been reported by J. Hall and Randall from the Chemung beds of northwestern Pa.

Rhipidomella pennsylvanica (Simpson) Plate 17 figs. 9, 10.

Orthis pennsylvanica Simpson, Tr. Am. Phil. Soc. n. s. 16, 1889, p. 437.

According to Simpson, "This species may be distinguished from *Schizophoria striatula* of the same formation, by its smaller size and more circular outline; from *Schizophoria tioga* by its more circular outline, less conspicuous mesial sinus and elevation, and oval muscular impression."

Occurrence.—In the Chemung group of Tioga county; on the P. and E. railroad between Ludlow and Wetmore, and in Kinzua Creek near the western line of McKean county, Pa., and 'elsewhere in Pa.'

DALMANELLA

Dalmanella tenuilineata (Hall) Plate 11, figs. 13, 14.

Orthis leonensis Hall, Pal. of N. Y. IV, 1867, p. 62, pl. 8, figs. 3-8.

The dorsal valve has a distinct longitudinal sinus and has the base more or less abruptly truncated in the middle. The ventral valve may be slightly elevated along the median line. The muscular impression is oval or ovate and somewhat visibly lobed. The area is shorter than the width of the shell. The surface striæ are strong. Specimens of this species are usually small.—*Hall.*

Occurrence.—In the arenaceous beds of the Chemung group near Leon, Conewango, and Randolph, N. Y.

Dalmanella tioga (Hall) Plate 17, figs. 1-4, 6, 12.

Orthis tioga Hall, Pal. of N. Y. IV, 1867, p. 59, pl. 8, figs. 20-29.

Shell transversely elliptical; dorsal valve with a well marked

sinus; ventral valve sometimes with a mesial elevation; foramen wide. Striæ angular and curving upward at the hinge-line. Every second stria on the upper part of the shell and every third or fourth on the lower part seem to be strongest. The shell structure is minutely punctate. Dorsal muscular impression indistinct; strong cardinal process present and bilobed apically. Ventral muscular impression sub-pentagonal and deeply bilobed below.

Occurrence.—Common in Chemung at Tioga, Pa., and also in Alleghany and Cattaraugus counties, N. Y.

STROPHEODONTA

Strophеodonta demissa (Conrad) Plate 15, figs. 4, 7.
Pal. of N. Y. IV, 1867, p. 81, pl. 11, figs. 14-17; pl. 12, figs. 1-5.

Occurrence.—In the middle and upper Chemung groups of New York and Pa. It is very common in Cattaraugus and Chautauqua counties, N. Y.

SCHIZOPHORIA

Schizophoria striatula (Schlotheim) Plate 17, figs. 5, 7, 8, 11, 15, 16.
Orthis impressa Hall, Pal. of N. Y. IV, 1867, p. 60, pl. 8, figs. 11-19.

The surface bears delicate radial striæ and the shell structure is punctate. The dorsal muscular impression is quadrilobate, and limited by widely diverging dental plates. Narrow vascular impressions extend below the muscular scar to the margin of the shell. The ventral valve is broadly sinuate in the middle. The muscular impression is triangular or sub-ovate and deeply bilobed. The general size and shape of this impression is extremely variable.

Occurrence.—A common Chemung species. Found frequently in western N. Y. and Pa.

CAMAROTŒCHIA

This genus is characterized by its rostrate rhynchonelloid appearance and its usual trihedral outline. The pedicle valve is usually shallow and the brachial more or less convex. The surface is radially plicated with a varying number of angular or subangular (sometimes rounded) plications. The brachial valve bears internally a medial septum which is posteriorly divided

forming an elongate spondylium. Each division of the septum supports one of the lateral divisions of the hinge plate, to which are attached the curved crural processes. There is no cardinal process. In the genotype *C. congregata* (Con.), the dental sockets are crenulate.

Due to the similarity of external characters in the different species of *Camarotœchia*, the dissimilarity of the various stages of growth of the same species, and the tendency to deviate from the mean of any specific characterization, the exact taxonomic classification of many forms is often obscure.

From the Chadokoin and Conewango several hundred specimens of this genus have been collected. A good portion of these have been referred to *C. contracta* (Hall), an almost equal number to *C. sappho* (Hall). We refer *C. orbicularis* (Hall) to synonymy under the discussion of *C. sappho*. A few specimens are being referred to *C. eximia* (Hall) but when more and better material has been collected these forms may be assigned to other species. From the Oswayo member we have a fair collection of *C. allegania* (Wms.). They are in the usual poorly preserved condition, i. e., molds and casts.

Camarotœchia contracta (Hall) Plate 12, figs. 1-2, 4-6, 11.

Atrypa contracta Hall, Geol. Rpt. Fourth Dist. N. Y. G. S. 1843, tb. 66, pl. 53, figs. 26-39.

Rhynchonella (Stenocisma) contracta (Hall) Pal. N. Y. IV, 1867, p. 351, pl. 55, figs. 26-39.

Rhynchonalla contracta, Herrick, Bul. Dennison Univ. III, 1887, p. 39, pl. 10, fig. 9; IV, p. 23, pl. 11.

Camarotœchia contracta, Hall and Clark, Pal. N. Y. VIII, pt. II, 1893 p. 192, pl. 57, figs. 28, 32, 49.

Camarotœchia contracta, Raymond, Ann. Carn. Mus. V, 1908, p. 141.

Camarotœchia contracta (Hall) Md. Geol. Surv. Upper Devonian, 1913, p. 577, pl. 53.

Camarotœchia aff. contracta, Girty, U. S. G. S. Prof. Paper No. 150 E, 1927, p. 117.

In the original description of *C. contracta* (Pal. N. Y. IV, 1867, p. 351) James Hall describes this species as having a gibbous dorsal valve, which is highest in the middle, and regularly

convex transversely. The surface is marked by about sixteen angular plications. This number may vary from sixteen to twenty. Of these, three are in the mesial sinus and four on the mesial fold. The plications on the fold originate from the posterior bifurcation of two mesial ones near the apex of the beak.

The two central ribs are larger than the two lateral ones. The boundary plications on the fold and sinus have especially broad inner slopes. The sinus is produced anteriorly in a linguiform extension.

Hall says also, in his original description, that the younger specimens may have but one or two plications in the sinus and a corresponding number on the fold. Other specimens of ordinary size have four plications in the sinus and five on the fold. In some specimens with very angular plications there are only five or six on each side of the fold and sinus.

The outline of the shell varies from subquadrate to ovate, or almost triangular. The anterior margin is usually broadly oval.

This species is very common in the Chemung and Conewango horizons and has been reported from the Waverly of Ohio[3] and doubtfully from the Pocono of Pennsylvania by Mr. G. H. Girty[4].

The dimensions of our specimen vary between 9 mm. in width and 8 mm. in length and 21 mm. in width and 19 mm. in length. The average dimensions of the species are about 17 mm. in width and 15 mm. in length.

The central ribs curve gently to the front and likewise the lateral ones. None bend abruptly to the sides. On about three hundred specimens examined the total count of ribs vary thus:

92	specimens	with	20	plications
107	"	"	18	"
89	"	"	16	"
4	"	"	15	"
4	"	"	14	"
2	"	"	21	"
6	"	"	22	"

The plications on the mesial fold and in the sinus vary as

[3]Pal. N. Y. IV, 1867, p. 351.
[4]U. S. G. S. Prof. Paper 150 E. 1927, p. 117.

follows (The arrangement (1-2) means that there is one rib in the sinus and there are two on the fold):

3	specimens	with	a	(1-2)	mesial	arrangement	of	ribs
189	"	"	"	(2-3)	"	"	"	"
177	"	"	"	(3-4)	"	"	"	"

This material comes from the following localities in southwestern New York and northwestern Pennsylvania. The horizons are for the most part from the Conewango[5] (Cattaraugus[6] and Oswayo[7]) of the Bradfordian series[8].

Pope Hollow, Chautauqua county, N. Y., Ptychopteria zone about 50-70 feet below the conglomerate at that place[9] in the Cattaraugus beds, yields many specimens. The measurements of typical specimens from this station are: 12 to 22 mm. wide, and 12 to 17.5 mm. long. The ribs number from 16 to 18, those on the center are mostly of the (2-3) arrangement and a few of (3-4) type.

One mile east of Stoneham, Pa., and about three miles southeast of Warren, Pa., in the Conewango near the contact of the "Cuyahoga" of Verwiebe[10] and the Sub-Olean. This zone also contains *Ptychopteria* but by no means as plentifully as the Pope Hollow locality. The width of specimens of a (2-3) median plication arrangement varied between 12 and 22 mm. and the length between 7 and 15 mm. Those specimens with (3-4) arrangement were 9 to 23 mm. wide and 8 to 17 mm. long. Some of the specimens are very flat and apparently naturally so. Several specimens have a very deep sinus which is abruptly bent upward and have a much elevated fold on which the plications are very well developed. The (3-4) mesial arrangement of ribs is the most common. The variation in the total number of ribs

[5]Girty, G. H., U. S. G. S. Folio No. 172, p. 4.
[6]Glenn, L. C., N. Y. S. Mus. Bul. No. 69, pp. 971-978.
[7]Ibid.
[8]Girty, Science, XIX, 1904, p. 4.
[9]Harris, G. D., Am. Geol., Mar. 1891, p. 164.
[10]Am. J. Sc. XLIII, 1917, p. 309.

is as follows:

1	specimen	with	21	plications
6	"	"	16	"
36	"	"	20	"
41	"	"	18	"
4	"	"	14	"
3	"	"	15	"

Stone Hill, one mile northeast of Stoneham, Pa. The specimens come from a very fossilferous stratum of the Conewango[11]. The specimens have for the most part 16 or 17 plications with medially (3-4).

Kinzua, Pa., 25 feet above the river. Bradfordian forms, rather poorly preserved.

Two miles northwest of Warren in Conewango the specimens were as follows:
Width varying from 20 to 22 mms.
Length varying from 17 to 20 mms.
Plications varying from 18 to 20, with 3 in sinus and 4 on the fold.

Camarotœchia allegania (Williams) Plate 14, figs. 1-2, 4-5.

Rhynchonella allegania Williams, U. S. G. S. Bul. No. 41, 1887, p. 87, pl. IV.
Camarotæchia allegania (Williams), Butts, Report N. Y. State Mus. No. 69, 1903, p. 994.

Camarotœchia allegania is in general appearance very similar to *C. sappho* (Hall). It has a large, broad shell, the ventral valve of which has a rather flat sinus and the dorsal valve a correspondingly flat fold. The fold and sinus bear from five to seven well defined rounded plications. Under the beak of the ventral valve there is a "broad flat tongue-like platform, representing a depression in the shell itself"[12]. It was noted in the original description that the cardinal teeth bear conspicuous serrations. The dorsal valve bears a short and strong median septum. The beak of the ventral valve is elongate and rounded

[11]This is the Berea of Girty (Ann. N. Y. Acad. Sc. XXII, 1912, pp. 295-319.) and the Venango First Sandstone of Verwiebe (Am. J. Sc. XLIII, 1917, p. 306.
[12]U. S. G. S. Bul. No. 41, 1887, p. 87.

and perforated at the extremity. There are from twenty to twenty-six plications.

This species was described from the ferruginous sandstones of the Little Genessee Rock City, N. Y. Williams mentions in the original description that *C. allegania* is closest related to *C. orbicularis* (Hall) or some variety of *C. sappho* (Hall) and it compared exactly with figures of *C. sageriana* (A Winchell) though it differed from the written description of that species.

In most instances the representatives of this species are in the form of rather badly crumpled casts or molds. The crumpled condition seems to point them out as thinner shelled forms than their associated rhynchonelloid kind. But they may have been littoral forms and wave action caused the crumpled condition. The fact that they are found almost exclusively in the coarse quartzitic sandstone of the upper Conewango would rather substantiate this view.

The most outstanding feaure of these shells, separating them from *C. sappho* (Hall) is the large platform-like muscular imprint on the internal mold of the pedicle valve. This is often much elevated and in some specimens occupies a large portion of the surface of the mold. The opening of the apex of the pedicle valve and the elongate condition of that apex are also characteristic.

Localities.—Upper beds of the Conewango (Oswayc?) at Kinzua, Pa.; the same horizon between Kinzua and Bradford, Pa.; Knapp's Creek horizon (Oswayo) at Flat Iron, near Olean Rock City, N. Y.; strata underlying the conglomerate on a hill by the main highway just east of Stickley, Pa.; the same horizon about half way between Stickley and Bradford, Pa.; the Oswayo at Glade, Warren county, Pa.; loose material near the base of the conglomerate on the hills south of Smethport, McKean county, Pa.; near the top of the Oswayo, two miles west of Smethport, Pa., in a railroad cut on the spur line at that place.

Retzia (?) sp. **Plate 11, figs. 7-12**

In the 'Venango First sandstone'[13] one mile east of Stone-

[13]See Verwiebe for the correlation at this place, which is the same horizon as Stone Hill.

ham, Pa., and at Stone Hill an abundance of a small rhynchonelloid brachiopod is found. The material is in the form of casts and molds. The general features are those of the Retzidæ and of the genera *Retzia, Homeospira* or *Rhynchospirina.* The internal characters are practically unknown from this material. The figures on Plate 11 and the Frontispiece show the forms as known from these two localities.

Camarotœchia sappho (Hall) Plate 12.

Rhynchonella sappho Hall, N. Y. State Cab. Nat. Hist. Rep. 13, 1860, p. 87.
Rhynchonella (Stenocisma) orbicularis Hall, Pal. N. Y., 1867, IV, p. 353, pl. 55, figs. 40-46.
Rhynchonella (Stenocisma) sappho Hall, **ibid** p. 340, pl. 54, figs. 33-34; pl. 55, figs. 47-52.
Camarotœchia sappho Hall and Clarke, Pal. N. Y. VIII, pt. II, 1893, p. 192, pl. 57. figs. 10-15.
Camarotœchia orbicularis, Hall and Clarke, **ibid**, pl. 51, figs. 46, 48, 49.
Camarotœchia sappho (Hall), Geol. Surv. Ohio, VII, 1895, p. 512, pl. 21, fig. 1
Camarotœchia sappho Grabau, N. A. Index Fossils, 1907, p. 268.
Camarotœchia sappho (Hall), Md. Geol. Surv. Upper Devonian, 1913, p. 174.
Camarotœchia oribicularis (Hall), **ibid**, p. 579, pl. 53.

The shells of this species vary in outline from broadly subtrigonal, in immature specimens, to transverse, sub-orbicular, or short-ovate, in adult specimens. The dorsal valve is usually the more gibbous.

The ventral valve is scarcely gibbous on the umbo and is usually depressed convexly. It is, however, occasionally a little transversely concave at about the middle of the shell. The posterior edges are usually slightly rounded, but in some forms they are almost straight or even slightly concave. The lateral margins meet acutely at the apex, which is usually incurved in the adult specimens. The anterior margins are slightly rounded. The center is gradually depressed in the median sinus which is ordinarily first perceptible at about the middle of the shell.

The dorsal valve is gibbous and arcuate from beak to base. The median fold is first defined at about the middle part of the shell, and is more elevated toward the anterior.

The surface is plicated by twenty to twenty-four ribs and in larger specimens there are sometimes more. There may be only fourteen or fifteen ribs on the immature shell. The ribs are strongest mesially, and become obsolete near the cardinal margin. There are usually four to seven plications in the median sinus and five to eight on the median fold. All of the central plications curve gently to the front of the shell. The lateral plications of the brachial valve are all abruptly bent toward the pedicle valve. Each rib is apically bifid for the reception of the corresponding rib of the opposite valve. The ribs on the sides are not as deeply slit as the central ones but the slit is wider. The surface of well preserved specimens is marked by fine thread-like, concentric, elevated striæ which are best defined toward the front.

The internal mold of the pedicle valve often shows a well marked muscular imprint which is delimited by a circular depression. This muscle scar extends toward the front for about half the length of the shell. At the rear it is mesially invaginated for a short distance. In the middle of this invagination there is a longiudinal sulcus which extends to the apex of the beak. The sides of the mold of the umbo are pustulose with ovarian markings. In some more perfect molds the cardinal margins of the pedicle valve show distinctly the serrate margins mentioned in the description of the genotype, *Atrypa congregata* Con. They are not as distinct in this species as in *C. allegania* (Wms.).

In his description of *C. orbicularis* (Pal. of N. Y., IV, 1867, p. 353) James Hall says, "This species presents many features in common with *Rhynchonella sappho* of the Hamilton group; and I am prepared to find in larger collections a graduation from one to the other."

In our material from the same horizon at which *C. orbicularis* was described, i.e., Upper Chemung (Conewango), no clear cut differentiation between *C. sappho* and *C. orbicularis* was possible. There was not merely a gradation such as Hall anticipated, but gradations in the same faunule.

Our upper Devonian material has been compared with many specimens in the Cornell University Museum from the Marcellus shale at Avon, LeRoy, Batavia, Stafford and Ithaca, N. Y.

We have been able to find no more pronounced gradation between these Hamiltonian and Upper Chemung specimens than almost any upper Chemung faunule shows among the specimens found therein. In other words, it seems that *C. sappho* is a persistant species which shows an almost limitless number of minor variations, one of which J. Hall referred to as *C. orbicularis*. We are referring *C. orbicularis* to synonymy under *C. sappho*.

The specimens from the Marcellus shale, which were examined, most frequently have five plications in the mesial sinus and six on the fold. There were, however, occasional specimens with a (4-5) or a (6-7) or even a (7-8) arrangement of mesial plications.

Among specimens of *C. sappho* from the Conewango in southwestern New York and northwestern Pennsylvania all of these arrangements of mesial plications are common, though in the latter faunules the (4-5) arrangement is most common.

The upper Devonian forms usually have about twenty to twenty-four plications and in rare instances a specimen has a greater number. While these super-plicated forms may represent a variety their occurrence with specimens possessing almost all the intermediate numbers of plications would seem to contradict this idea. In both Hamilton and Bradfordian strata there are occasionally found specimens which are a bit more ovate or a little more gibbous than others in the same faunule. Since these fluctuations occur in specimens from both strata one is led to suppose that he is dealing with normal and slightly over developed representatives of the same species rather than distinct species or even varieties of one species. In some of the more transverse specimens this gibbous condition is traceable in part to anterior-posterior compression during fossilization.

Locality characteristics:—The characters of some of the better preserved specimens from the base of the Conewango at Stone Hill, south-east of Warren, Pa., are as follows:

20 plications; 4 in the sinus and 5 on the fold; width 24 and length 19 mm.

24 plications; 4 in the sinus and 5 on the fold; width 23 and length 20 mm.

23 plications; 5 in the sinus and 6 on the fold; width 17 and length 14 mm.

22 plications; 5 in the sinus and 6 on the fold; width 20 and length 17 mm.
25 plications; 6 in the sinus and 7 on the fold; width 27 and length 23 mm.
20 plications; 4 in the sinus and 5 on the fold; width 28 and length 21 mm.

In the form with the (6-7) mesial arrangement of the ribs the dorsal fold has five plications in front and seven at its origin at about the middle of the shell. The two lateral ribs become obsolete before they reach the front margin. In one unusually gibbous brachial valve the fold is almost undifferentiated. The mold of the large ventral valve (the specimen 28 mm. wide, above) has much flattened ribs and a large muscular impression on the umbo.[14]

From Black Creek, Hudson township, Alleghany county, N. Y., in the upper Chemung (Conewango) several specimens were obtained which represent several stages in the growth of the species. One specimen has an abnormally large number of plications. The material is for the most part rather poor.

Several specimens came from the Venango First Oil Sand horizon of Verwiebe[15] about three miles south-east of Warren Pa., and one mile east of Stoneham, Pa.

From Glade, Warren county, Pa., in the Conewango at about the horizon of the 'Lamellibranch series' of G. D. Harris[16] in his section at Pope Hollow. The specimens are usually large, the width being about 26 mm. and the length about 20 mm. The plications are subangular, and five are in the sinus and six on the fold.

From a very calcareous shale two miles northwest of Warren, Pa., in strata referred to the Conewango particularly fine specimens are obtained, measuring:

Length	Width	Length	Width
17 mm	27 mm	14 mm	17 mm
18 mm	23 mm	17 mm	25 mm
23 mm	25 mm	24 mm	26 mm
20 mm	26 mm		

[14]For this locality, see U. S. G. S. Folio 172.
[15]Am. Journ. Sci. XLIII, April 1917, p. 309.
[16]Amer. Geol. VII, Mar. 1891, p. 164.

The plications vary from 20 to 28, the commoner numbers being 21, 22, or 23. There are 4 or 5 plications in the sinus and on the fold. (One specimen has a (6-7) mesial plication arrangement.)

From beds immediately underlying the Sub-Olean conglomerate at Stoneham, Pa., we have several specimens of *C. sappho*. On several specimens the plications are angular. On another with 28 visible plications they are all rounded. On this specimen the brachial fold is not elevated.

From the Bradfordian of Warren, Pa., the exact horizon undetermined, we have several young specimens of *C. sappho*. They have the usual trihedral shape and angular plications which are characteristic of the immature of this species.

We also have material from the Conewango at Kinzua, Pa. In the Oswayo at this place, a coarse quartzitic sandstone with clay inclusions, the specimens are well preserved and are normal. With them are associated *C allegania* (Wms.).

CYRTINA Davidson

Shell small, spiriferoid, valve very unequal. The semi-pyramidal form of the pedicle valve, the high flat cardinal area, and the narrow delthyrium closed by a pseudo-deltidium, which is usually perforated by a circular foramen, separate these from the Spirifers. The shell structure is punctuate. The dental plates converge from the inner margin of the delthyrium and unite with the median septum, which reaches to the front, thus dividing the interior of the valve in two parts. Nearly the whole interior of the shell is taken up by two spiral cones, the apices of which extend into the rostral cavity of the ventral valve.[17]

Cyrtina triplicata Simpson Plate 14, figs. 2-10.

Cyrtina triplicata Simpson, Tr. Am. Phil. Soc. 16, 1888, p. 439.

Cyrtina triplicata Simpson, 2nd Pa. Geol. Surv., Dict. Fos. 1889, p. 181.

Description[18]:—Shell more or less triangular, sub-pyramidal; hinge-line equal to the greatest width of shell; proportional length and width somewhat variable; length of the dorsal valve from one-half to two-thirds the width; length of ventral valve about equal to the width; height of the area greater than the length of the dorsal valve.

[17]Original description of the genus, Pal. Soc. London, 1858, p. 66. Description in part from Grabau and Shimer **Index Fossils** and in part from James Hall, Pal. N. Y. IV.

[18]Taken in part from Simpson's original description.

Ventral valve quadrilateral, sub-pyramidal; most prominent at the beak, which is variable in elevation; straight not arching over the area, usually attenuate; lateral margins regularly rounded. Mesial sinus narrow at the beak and rapidly widening as it exends forward, and deep; where it reaches the margin of the shell it is produced forward in a sub-linguiform extension. Sides of the sinus flat, abruptly sloping, making the bottom angular. Area large, triangular, varying in height; sometimes nearly equal to the width of the shell, at other times not equal to more than half the width; slightly oblique; striated in both directions, the longitudinal striæ distinct, the vertical striæ much finer and often obsolete. Fissure moderately narrow and closed by a convex pseudo-deltidium.

There are three or four plications on each side of the sinus, the two bounding the sinus being much more prominent than the others.

Dorsal valve semi-circular or subtrigonal in outline; length from one-half to two-thirds the width. Mesial fold broad, prominent, extremely elevated in front and bounded by broader furrows than those between the plications. There are two plications on each side of the mesial fold, the two plications adjacent to the fold being much more prominent than the others. On some of the specimens these are nearly as prominent as the fold itself, the other two plications being obscure.

The surface of both valves is ornamented by very fine and delicate striæ which are obsolete on all but perfectly preserved specimens. There are also many conspicuous lines of growth which are more prominent on the anterior portions of the shell.

Dimensions of two specimens compared:

Length	5, 4.5 mm brachial valve
	6, 5.5 mm pedicle valve
Width along area	8.3, 8 mm
Height of area	4.5, 4 mm
Width of delthyrium	1,1 mm. at base.

The species was originally described from the "Chemung" group three miles northwest of Warren, in Warren county, Pa. It has also been recorded by Randall from Warren, Pa.[19]

[19]2nd Pa. Geol. Surv. Dictionary of Fossils.

Our specimens came from the Waverly at Stone Hill, Pa., not far south of Stoneham, Pa. It is the Cuyahoga formation of Verwiebe[20] or the Venango First Oil sand of geologists. The matrix is a light gray sandstone which weathers to a buff color and has an abundant fauna.

PARAPHORHYNCHUS Weller

Shell rostrate, of rather large size, coarsely plicate with usually simple plications which extend nearly to the beak, with a deep sinus in the pedicle valve and an elevated fold in brachial valve of the mature shell. The surface of both valves is marked with very fine longitudinal striæ which increase by bifurcation and intercalation. In the interior of the pedicle valve there is a pair of vertical dental lamellæ which support the teeth and extend forward into the cavity of the valve and between which there is a narrow muscular scar. In the brachial valve a strong median septum supports posteriorly a hinge plate with a median cruralial-like cavity. Anteriorly each lateral division of the hinge plate is produced into the cavity of the shell as a crural process. The median septum also continues forward toward the front of the shell beyond the cruralium-like hinge plate. A cardinal process is wanting. The shell is fibrous in structure, not punctate.[21]

Paraphorhynchus medialis (Simpson) Plate 11, fig. 28.

Rhynchonella missouriensis, Carll, 2nd. Pa. G. S. XIV, 1883, p. 305.
Rhynchonella medialis Simpson Tr. Am. Phil. Soc. n. s. XVI, 1888, p. 414, fig.
Rhynchonella medialis Simpson, Lesley, 2nd. Pa. G. S. Dict. Fos., p. 4, 1889, p. 892.
Rhynchonella medialis, Randall, Pa. G. S. Final Rep., II, 1892, p. 1494.
Rhynchonella medialis, Schuchert, U. S. G., Bull. No. 87, 1897., p. 360.
Paraphorhynchus medialis (Simpson), Weller, Tr. Acad. Sci. St. Louis, XV, 1905, p. 259.

Description[22].—Shell broadly oval or sub-trigonal in outline; height a little less than width; greatest width about two-thirds the length of the shell from the beak. Margins from apex to widest part of the shell nearly straight, then abruptly rounding and slightly produced in front in a broad extension.

[20] Verwiebe, Am. J. of Sc. 18, April 1917.
[21] From Weller, Tr. Acad. Sci. St. Louis, XV, 1905, p. 260.
[22] Simpson's original description, see above.

Ventral valve convex at the sides, depressed in the middle; mesial sinus commencing at the apex and growing wider at the base, where it occupies fully one-half of the width of the valve.

Dorsal valve unknown.

Surface marked by about twenty plications, of which eleven occupy the mesial sinus, and are smaller than those on the other parts of valve, there being five in the same space occupied by three of the others. The plications are rounded or subangular. There are also very fine radiating striæ covering the plications, four or five in the space of one millimeter. The striæ are crossed by lines or varices of growth. No concentric striæ have been observed, though they may occur on more perfectly preserved specimens. The specimen described measures 25 mm. in height and 30 mm. in width.

The species was described from the "Waverly" group near Warren, Pa.

Remarks.—The specimens pictured come from the Bradfordian beds lying between the Olean and Sub-Olean conglomerate on Stone Hill, one mile east of Stoneham, Pa., and from the same horizon on a hill just east of Cobham, Pa. The specimens are internal molds and external casts in a coarse grained, almost conglomeritic sandstone which in places is a true conglomerate. They were associated with *Spirifer disjunctus, Syringothyris angulata* and *randalli, Cyrtina triplicata, Camarotœchia sappho* and *contracta* etc.

The internal mold of the pedicle valve which was best preserved is 28 mm. in length and 30 mm. wide. The posterior lateral portions of the umbo are pustulose with ovarian markings. The cast of the diductor muscle scars extends anteriorly about 13 mm. on the umbo and is lenticular in shape. The imprint of the vascular system is very pronounced on the internal molds. One main vascular trunk extends toward the front on either side of the umbo. Each bifurcates once just posterior to the termination of the diductor muscle scar. Of the two sectors after this bifurcation the central one bifurcates once, while the lateral sector repeatedly bifurcates and sends branches toward the posterior margin. From these multiple branches of the lateral sectors the secondary vascular sinuses extend to the periphery of the shell in a pectinate manner.

Paraphorhynchus girtyi n. sp. Plate 9, figs. 15, 17, 18, 19, 22.

Shell large, semi-globular, sub-quadrate in general outline; external appearance very rugose with heavy radial plications and fasciculating concentric ribbing.

Ventral valve larger than the dorsal, less gibbous and with greater concentric irregularity. The surface of the internal mold has very coarse plications, four of which are in the mesial sinus and three or four on the sides. The surface is not known but undoubtedly is finely striate as it is in the other members of the genus. Large, elevated, concentric carinæ probably formed by fasciculating growth lines are a characteristic feature of the internal molds of both valves. The individual concentric striæ are best seen in the anterior part of the sinus where they are angular.

The dental lamellæ are short and strong and about six millimeters apart. Between the dental sulci of the mold there is an elevated elongate-ovate muscular platform from the margins of which extends a well developed system of vascular sinuses. On the posterior dorsal side the pedicle umbonal mold is excavated as though marking the position of a cardinal plate.

The dorsal valve is shorter and more gibbous than the ventral. It has five mesial plications on a moderately elevated fold and three well developed laterals. This valve has a very rugose appearance due to five or six very heavy concentric carinæ, in the mold form, and very strong concentric striæ. A well developed median septal imprint is shown on the mold, and dental sockets are visible cardinally.

This species differs from *P. medialis* in the fewer number of mesial ribs, the rugose appearance, the wider and less perfectly defined muscular impression. The dental lamellæ of *P. girtyi* are also larger.

Dimensions.—Width 29 mm.; height 26 mm.; greatest thickness about 18 mm.

Occurrence.— At the Venango First Oil Sand horizon, above the Sub-Olean conglomerate on the road from Scania to Smethport, Pa. The matrix is a light gray quartzitic sandstone.

Paraphorhynchus striata, (Simpson) Plate 9, figs. 16, 20.

Tr. Am. Phil. Soc. N. S. 16, 1889, p. 444.

Shell broadly triangular; posterior lateral margins nearly straight; greatest width of shell anterior to the middle. Species known from ventral valves only.

The mesial sinus originates early on the beak and widens greatly upon approaching the anterior margin. There are five or six plications in the sinus of a medium sized specimen and four or five on a larger one. Three very broad rounded anterior-lateral ribs are well shown on the smaller specimen and obsolete or eroded on the larger. The extreme sides are smooth.

The surface of an external cast shows indistinct radiating striæ on the bases of the sinal costæ. Concentric growth lines are present.

Internally the shell has two stout incurving dental lamellæ which extend toward the front about one-seventh the length of the shell. The diductor muscles are imbedded in the shell in an oblong depression, in the longitudinal median portion of which the adductors are attached. Just posterior to the diductor there is an elevated ridge which extends posteriorly on the beak creating an appearance, in the internal mold, very analogous to the same region in many of the *Syringothyris,* in which the posterior or middle part of the umbonal mold is notched; this may represent the attachment place of the posterior adductors. Ovarian markings are plentiful on the lateral slopes of the umbo.

Occurrence.— These specimens come from the Venango First Oil Sand horizon between the Olean and Sub-Olean conglomerates near Cobham, Pa. The matrix is a yellowish brown quartzitic sandstone which is very fossiliferous. It is this stratum which was formerly known among Penna. geologists as the "Berea" formation, and is quite probably the type locality for the species.

PRODUCTELLA

Productella hirsuta Hall Plate 20A. figs. 11-19.

Pal. of N. Y. vol. IV, 1867, p. 166, pl. 24, figs. 17-29.

Occurrence.—In the green arenaceous shales of the Chemung group at Phillipsburg and Rockville, Alleghany county, N. Y., and at Covington, Pa.

Productella hirsuta var. **rectispina** Hall. Plate 19, fig. 11.

Pal. of N. Y. IV, 1867, p. 168, pl. 24, figs. 30-37.

Occurrence.—This variety occurs in the Chemung beds of Steuben county, N. Y., and in the beds referred to the Chemung by Hall at Meadville, Pa.

Productella boydii Hall. Plate 20A, figs. 1-6.

Pal. of N. Y. IV, 1867, p. 169, pl. 24, figs. 10-16.

Occurrence.—In the Chemung group at Phillipsburg, N. Y., and reported by Verwiebe from the Venango Oil group. (A. J. Sc. 44:92.)

Productella lachrymosa (Conrad) Plate 20, fig. 14.
Plate 19, figs. 8-10.

Pal. of N. Y. IV, 1867, p. 172, pl. 25, figs. 23-28.

Occurrence.—Common in the Chemung group. Found by Hall in western New York near Conewango, Randolph, and Ellington; reported by Lesley from the "Chemung-Catskill" beds at Warren, Pa. (Dict. of Fossils, p. 750.)

Productella lachrymosa, var. **lima** (Conrad) Plate 19, figs. 18-21.

Pal. of N. Y. IV, 1867, p. 174, pl. 25, figs. 29-32.

This variety differs from *P. lachrymosa* in having a depressed middle and shorter and more numerous tubercles.

Occurrence.—Found with *P. lachrymosa* in the Chemung group at Randolph, South Valley and Ellington, N. Y., and reported by Prosser from the Bedford shales at Penn Line, Pa. (Geol. Surv. of Ohio, Bul. 15, p. 391.)

Productella lachrymosa var. **stigmata** Hall Plate 19, figs. 12, 13.
Plate 20, figs. 1, 2.

Pal. of N. Y. IV, 1867, p. 174, pl. 25, figs. 33-41.

"This is one of the largest forms among Chemung species; and I am inclined to believe it may be ultimately proven specifically distinct from *P. lachrymosa.*"—J. Hall.

Occurrence.—In the light colored sandstone of the "Chemung group" near Olean, N. Y., and in a similar rock at Conewango and in the lower, decomposing, semi-calacareous layers at Randolph and East Randolph, N. Y.

Productella speciosa Hall **Plate 19, figs. 4-6.**

Pal. of N. Y. IV, 1867, p. 175, pl. 25, figs. 1-11.

"This species resembles some of the forms of *P. lachrymosa,* but the spiniferous tubercles are smaller and more closely arranged and more numerous, while the umbo of the ventral valve is narrower and somewhat more attenuate. The dorsal valve is studded with numerous tubercles on the internal surface, while in that species the surface is papillose with indistinct wrinkles and some distinct elevations. In *P. lachrymosa* the divisions of the cardinal process are more divergent and each division is again bilobed; while in this one the divisions appear simple."—J. Hall.

Occurrence.—Originally found in the Chemung group on Twenty Mile Creek in Chautauqua county, N. Y. It also occurs at New Albion and Leon, N. Y., and west of Olean.

Productella striatula Hall **Plate 20A, figs. 7-10.**

Pal. of N. Y. IV, 1867, p. 177, pl. 25, figs. 14-21.

Occurrence.—In some semi-calcareous bands in the Chemung group at Cherry Creek, and New Albion, Conewango, and Cold Spring, N. Y.

Productella costatula Hall **Plate 19, figs. 1-3.**
Plate 20, figs. 10-13.

Pal. of N. Y. IV, 1867, p. 180, pl. 26, figs. 9-15.

Occurrence.—This species occurs commonly in the Chemung group. It was originally cited from the Chemung Narrows in Chemung county; East Randolph and Randolph, Napoli, Conewango, New Albion and elsewhere in Cattaraugus county, N. Y.

Productella acutirostrata Hall **Plate 19, fig. 7.**

Pal. of N. Y. IV, 1867, p. 182, pl. 26, figs. 16-23.

Occurrence:—Originally described from the Chemung group at Jasper and south of Cadiz, N. Y. The illustrated specimen came from a light brown sandstone at Leon, N. Y., where it was associated with many *Ambocœlia umbonati*

Productella bialveata Hall — Plate 19, figs. 14, 15. Plate 20, figs. 3, 4.

Pal. of N. Y. IV, 1867, p. 183, pl. 26, figs. 24-28.

Occurrence.—"In a sandstone of the Chemung at Meadville, Pa., where it is associated with *Spirifer disjunctus* and other fossils of the age of the Chemung group."—J. Hall.

Productella onusta Hall — Plate 19, fig. 17. Plate 20, figs. 5-9.

Pal. of N. Y. IV, 1867, p. 184, pl. 26, figs. 29-42.

Occurrence:—In the arenaceous and semi-calcareous beds at Conewango, Napoli and near New Albion, N. Y.

SPIRIFER

Spirifer disjunctus Sowerby — Plates 2 and 3.

Spirifer disjuncta Sowerby, Tr. Geol. Soc. 2nd. ser. 1840, pl. 53, fig. 8, pl. 154, figs. 12-13.

Spirifera verneuili Murchison, Geo. Soc. France, Bul. XI, 1840, p. 252, pl. 2.

Delthyris chemungensis Conrad, Journ. Acad. Sci. Phila. VIII, 1842, p. 263.

Delthyris cuspidata Hall (non Martin), Geol. N. Y. State, Rpt. 4th. Dist. p. 270.

Delthyris disjuncta, Hall ibid., p. 269, fig. 3.

Spirifer disjunctus Davidson, Quart. Journ. of Geol. Soc. IX, 1852, p. 354, pl. 15.

Spirifer disjunctus Hall and Clarke, Pa. N. Y., VIII, pt. II, 1893, pp. 21, 24, 27, 37, 49, pl. 30.

In the Bradfordian and Chautauquan series of the Paleozoic there is probably no more characteristic species than *S. disjunctus.*

Although *S. disjunctus* is extremely variable in form, a general characterization might be as follows: Shells of moderately large size, the hinge line usually the greatest width of the shell. The area varies in height from moderately high to high and is usually distinct. The fold and sinus are plicate, the number of plications thereon varying. The lateral plications are simple and those in the sinus and on the fold are dichotomous, bifurcating or intercalary.

As J. Gosslet[23] has pointed out in his examinations of *S. verneuili* the European *S. disjunctus,* there are about six variations in the general shape of *disjunctus.* His groups, based on the relation of length to width, are in themselves almost self-

[23]For a full discussion of this article see: Wms. U. S. G. S., Prof. Paper 79, 1913.

explanatory. They are: *Cylindrici, Attenuati, Elongati, Hemicycli, Proquadrati, Ovati.* Probably every specimen passes through several of these groups in its development, before reaching the mature stage.

In addition to radial plications the surface is marked by fine concentric striæ and also fine radiating striæ. These minute surface markings are usually eroded. The minute radiating striæ have a tendency to break up into pustules.

The variety *S. disjunctus sulcifer* of Hall and Clarke is rather common in a number of localities in the Bradfordian strata (see Pl. 3 fig. 8). This is characterized by having a sulcus on the middle of the median fold and often a mesial carina in the sinus.

These forms of *S. disjunctus* have slight variations or, at least, features infrequently seen on specimens from lower strata. The illustrations and the ensuing locality discussion will sufficiently depict these characters be they minor variations or apotypical features.

Locality discussion.—The upper beds of the Conewango at Glade, N. Y., yield some very fine internal molds and external casts of *disjunctus.* This horizon is characterized by the many fine specimens of *Ptychopteria beecheri* Hall. The matrix is a light gray quartzitic sandstone and the molds and casts are usually stained light brown. The dimensions of five average specimens from this locality are:

Ventral valves width 55 mm. and length 34 mm.
width 57 mm. and length 42 mm.
Brachial valves width 55 mm. and 30 mm.
width app. 42 mm. and length 34 mm.
width 50 mm. and length 25 mm.

The sinus is deep and broad and finely radiate, the radii increasing by bifurcation. The angles are slightly attenuate and the cardinal area of one fine specimen shows the imprint of the vertical striæ. (Plate 2, figs. 1, and 1a.). The dental lamellæ are short and strong (pl. 2, fig. 2). The dorsal valve is regular, obovate, the ribs on the fold finer than elsewhere. (Pl. 2, fig. 3.) In an older and more gibbous specimen the striæ are much coarser on the fold than in the average and the whole shell is

more rugose. (Pl. 2, fig. 4.) Another specimen shows the attenuate condition of the cardinal angles very well (Pl. 3, fig. 10).

Close to the contact of the Cattaraugus and the Sub-Olean one mile east of Stoneham, Pa., and three miles south-east of Warren, Pa., there are limy layers in the sandy shale which contain many *S. disjunctus*. They are all nearly ovate and of large size. One very short and attenuate specimen comes from the same place. Near the margin of the shell on one specimen there is a remarkable constriction. The dorsal valve of another specimen shows a peculiar imprint on the cast, of a development similar to a median septum in other genera.

At the top of the Conewango three-fourths of a mile east of Glade, Pa., the Spirifers are abundant and noteworthy. Giant proportions are the rule at that place. Some are especially gibbous. Some of the pedicle molds exhibit a very large muscular impression (pl. 2, fig. 7) and the cardinal area is very concave. In another pedicle mold there is a very great extension of the posterior muscle impression along the median axis, thus creating the appearance of a misplaced syrinx. This appearance is further strengthened by an angular sulcus which lies in the bottom of the impression. The dental plates of the specimen under discussion, are abnormally long. Other specimens seem to represent gradational stages in the development of the elongate depression in the pedicle mold. This, by reversal would represent a shelf in the shell, probably the attachment-seat of the posterior adductor muscles.

S. disjunctus, in the Cattaraugus, at Black Creek, Alleghany county, N. Y., is very attenuate and approaches Sowerby's original figures in appearance. Several *S. disjunctus* var. *sulcifer* are also common at this locality.

At Stoneham, Pa., associated with *Spirifer alleghaniensis* and *Syringothyris angulata* were also found several specimens of *S. disjunctus* var. *sulcifer.*

Among the *S. disjunctus* from Glade, Pa., (in the equivalent of the Ptychopteria zone at Pope Hollow, N. Y.) the dental lamellæ are consistently longer and closer together than in typical specimens.

The Oswayo formation two miles west of Smethport, Pa.,

contains many *S. disjunctus.* The beds are well exposed along a spur railroad which goes over the mountain west of the town. The fossiliferous strata is a shell limestone and calcareous shale which weathers to a dark brown color. With *S. disjunctus* are associated many *Syringothyris angulata* and *Rhynchospirina scansa.*

Collections were also made at the following places:

The Conewango formation in Mud River, north of Warren, Pa.; Knapps formation (Oswayo) at Flat Iron Station, near Olean Rock City, N. Y.; one-half mile north of Smethport, Pa., in shales about 150 feet below the conglomerate (Sub-Olean?); lower Conewango, Stonehill, near Stoneham, Pa.; Oswayo, east of Cobhams Hill, near Stoneham, Pa.; in a light brown quartzitic sandstone, below the base of the Olean conglomerate, on the hill just south of Smethport, Pa., (The Devil's Den); Panama conglomerate (basal Bradfordian), Panama, N. Y., and at Rock Ledge near Panama, N. Y.; shales along the river at Kinzua, Pa.; Oswayo at Stickley, Pa. (This is just below the Olean conglomerate); lower Conewango at Bradford, Pa.; Robin Hill east side (middle and top), on the Chautauqua-Cattaraugus county line, N. Y., about a mile north of the Pennsylvania boundary line.

Spirifer allegheniensis n. sp. Plate 4, figs. 1-6; 9-11.

Shell variable in outline; usually semi-circular; hinge-line straight or only slightly angled; pedicle valve elevated; brachial valve flattened; width about 37 mm. and length about 17 mm. Surface appearance usually very rugose, especially that of the internal molds. There are from 14 to 19 coarse ribs (occasionally more) on each side of the mesial region and from 4 to 6 ribs thereon. Both lateral and mesial ribs increase by intercalation and bifurcation; the lateral bifurcation is usually restricted to the five or six ribs nearest the fold or sinus. Trifurcation is not uncommon. Deeply impressed concentric lines intersect the ribs thus causing the aforementioned rugosity.

The ventral valve is most gibbous toward the rear. The beak is slightly elevated. The sinus is shallow and begins early on the beak and extends to the margin where it ends in a very slight linguiform extension. The plications immediately bordering the

sinus are usually larger than the others. Near the margin, regular concentric striæ are visible. These are continuous with the heavier varices which give the mold such a crepe-paper like appearance. The imprint of the muscular scars on the mold is much elevated. The scar is longitudinally striate, the striæ grouping themselves on either side of a slight elevation in the middle. The elevation is distinctly separated from the remainder of the shell by the abruptness with which it rises. The scar is slightly bifid behind. The cardinal slopes are pustulose with ovarian markings. The dental lamellæ are short and stout.

The boundaries of the cardinal area meet at the center at an obtuse angle.

The median fold is usually not much elevated but is very conspicuous due to deep sulci on each side of it. Two cardinal teeth are present.

This species bears some resemblance to *S. marionensis* which also has bifurcating lateral plications and undifferentiated fold and sinus. But the two species are very dissimilar in the character of the area boundaries. They are parallel in *S. marionensis* and the area of our specimens is broadly subtrigonal. In this respect they are similar to the much smaller species *S. vernonensis*. None of our specimens have the linguiform extension of the sinus of *S. vernonensis*.

This species is found in abundance in the highly fossiliferous sandstone on Cobham's Hill northeast of Warren, Pa. These are the beds called 'Corry sandstone', made a correlate of the 'Berea' by Girty[24] and later corrected to a correlate of the Venango First Oil Sand by Verwiebe[25]. On Stone hill east of Stoneham, Pa., at the same horizon it is also abundant.

CYRTIA Dalman

The shells of this genus range in size from small to medium. They have a straight hinge-line which is the greatest width of the shell. The fold and sinus are well developed and are usually plicated. The sides are usually plicated. The cardinal area of the pedicle valve is well developed, and may be flat or arched; the delthyrium is very narrowly triangular and is covered by a pseudo-deltidium. Then dental lamellæ are well developed and often reach the middle of the shell. The brachial valve has no median

[24] N. Y. Acad. Sc. Ann. 1912, p. 309.
[25] Am. J. Sc. XLIII, 1917, p. 305.

septum. There is sometimes present a tube which extends into the inside of the shell. The structure of the shell is impunctate.

Cyrtia alta (Hall) Plate 3, fig.

Spirifer alta Hall, Pr., Am. Phil. Soc. X, 1866, p. 246.
Spirifer alta Hall, Pal. N. Y. IV 1867, p. 248, pl. 43, figs. 1-7.
Syringothyris alta, Schuchert, 9th Rep. N. Y. S. Geol., 1890, p. 35.
Cyrtia alta, Hall and Clarke, **id.** VIII, pt. II, 1893, p. 42, pl. 26, figs. 1-5; pl. 39, figs. 37, 38.
Cyrtia alta, Prosser, G. S. Ohio, 4th. Ser., Bul. 15, 1912, p. 536.

The shell is semi-pyramidal with the hinge line representing the greatest width of the shell. The shell has a triangular outline when viewed cardinally and a semi-oval outline when viewed dorsally. The surface is plicate. The sinus and fold are usually plicate.

The ventral valve is much elevated. The breadth and width are about as 3 to 5. The sinus is broad and rounded at the bottom. In our specimen the pseudo-deltidium extends about two-thirds the height of the fissure. The delthyrium is 18 mm. high and 8 mm. wide at the base. The area is flat for about two-thirds the length of the shell, and then abruptly arches. A syrinx or curved septum penetrates the umbonal mold in an antero-ventral direction. There seems to be no transverse plate present from which this 'syrinx' arises. The dental lamellæ are large and converge both toward the brachial valve and toward the rear. At the cardinal area the dorsal convergence is interrupted by the diverging margins of the delthyrium. The muscular scars are represented by longitudinal striæ on the umbonal mold.

C. alta is associated with *Spirifer disjunctus, Syringothyris randalli* and *angulata,* and *Camarotœchia contracta* and *sappho* in the Conewango strata at Stoneham, Pa.

SYRINGOTHYRIS

Syringothyris angulata Simpson Plates 6, 7, 8.

Syringothyris angulata Smip. Am. Phil. Soc. Tr., XVI, 1889, p. 440.
Syringothyris randalli Simp. **ibid.** p. 441.
Syringothyris angulata, Schuchert, 9th Rep. N. Y. S. Geol., 1890, p. 32.
Syringothyris randalli, Schuchert, **ibid.** p. 36.
Syringothyris randalli, Hall and Clarke, Pal. N. Y. VIII, pt. II, 1893, pl. 27.
Syringothyris randalli, Schuchert, Am. Jour. Sc. 1910, vol. 30, p. 223.

The shape is spiriferoid, varying from semi-elliptical or semi-ovate to narrow and attenuate. The gibbosity of the shell differs

with age; old specimens are usually very gibbous and young ones regularly convex. Both valves are radially plicate on the sides. The fold and sinus are without plications. The cardinal area of the ventral valve is relatively high and may be either vertical or arcuate. The delthyrial aperture is comparatively narrow and is usually closed by a pseudo-delthryium. In some specimens this seems either partially or totally absent.

The plications of the ventral valve begin high on the beak and increase in elevation as they approach the anterior margin. They are usually sub-angular. The sinus likewise begins early on the umbo and widens toward the front where it is produced in a linguiform extension which is rather variable in the extent of its development.

The dental lamellæ are usually very elongate and bent convergently toward the front. They often nearly attain the anterior margin of the shell. In other quite normal specimens the lamellæ are little developed and straight.

In the mold of the pedicle valve the area between the lamellæ which bears the muscle scars is often elevated and posteriorly split.

The muscle scar is ordinarily very large and some instances reaches anteriorily more than two-thirds the length of the shell. This is of an ovate or sub-quadrate outline. The scar is usually made up of two bilaterally symmetrical interweaving webs of branching 'veins'. These are, on rare occasions, reduced to a series of longitudinally parallel 'veins'. The two portions of the scar are separated by an elongated platform which is laterally delimited by sulci. It is the posterior union of these sulci which forms the slit in the mold at the apex of the umbo mentioned above. In several specimens the sulci are posteriorly much widened but are separate all the way to the apex of the shell. Another common variation is that the sulci are so deep that they become part of the syrinx. The lateral slopes of the sides of the beak are usually marked by pustulose ovarian impressions.

The characters of the delthyrial parts as seen on the internal molds are as follows: The dental lamellæ converge slightly about the middle of the pedicle height. Connecting this convergence and sloping from the beak toward the brachial valve in a transverse septum which is usually dorsally angulate. This septum

has never been observed extending past the front limits of the dental lamellæ. On the pedicle side the septum usually has developed mesially two parallel carinæ which converge ventrally thus forming a slit tube. This tube which is called the syrinx extends toward the brachial valve far beyond the limit of the transverse plate. The syrinx may be entirely tubular with no slit along the pedicle margin or it may be only a solid rod extending into the interior of the shell. The transverse plate is sometimes not dorsally angulate, but instead is flat, rounded, or angularly concave. In still other specimens the transverse plate is totally absent and the syrinx alone is present.

The dorsal valve is less elevated and less gibbous than the ventral and has no cardinal area. Two well defined dental sockets are present anteriorly on each side of the umbo. A strong median septum extends toward the front for two or three millimeters. Internally along the median fold a very slight carina is often present and creates the impression in the mold of a slight plication tho it does not extend far toward the front, and is totally absent externally. The fold is well elevated and reaches forward in a more or less linguiform extension.

The surface of the entire shell is uniformly marked by flattened ctenæ which gives the surface the twilled cloth appearance so characteristic of the genus. Strong concentric growth lines are usually present. They are so well developed on some specimens as to give a very rugose appearance.

This species can be immediately distinguished from any of the associated spiriferoids by the total absence of plications on the fold and sinus and the presence of the syrinx.

A comparison of the above description with that of Simpson will show many points of major difference. This description is based on characters observed on several hundred specimens of *S. angulata* from many localities in the Conewango formation in western New York and Pennsylvania and the specimens of the species *S. randalli* Simp. from the N. Y. State Museum.

Neither any of our specimens nor the types of *S. randalli* in the New York State Museum have a plicate fold or sinus as illustrated in the original description of that species. (Tr. Am. Phil. Soc. XVI, p. 441, fig. 2). This same fact has been pointed out

by Girty in discussing this genus[26]. This error in the original description can only be explained by the fact that there are often associated with *Syringothyris* many *Spirifer disjunctus* which are mesially plicate. The imperfect cast or mold of one of these must have been the basis for the assumption that the species *S. randalli* was mesially plicate. Thus far no mesially plicate *Syringothyris* has been found in the Conewango.

Since the two species described by Simpson as *S. randalli* and *angulata* are identical and *S. angulata* occurs first in the original publication this species must by priority be known as *S. angulata* Simpson.

Localities at which *Syringothyris angulata* were collected are as follows: Stickley, Pa., in the conglomerate (Salamanca); Oswayo beds one-half mile east of Mt. Jewett, Pa., on the road to Smethport, Pa.; white sandstone immediately under the conglomerate (Olean) at Allegheny Springs, Warren Co., Pa.; Conewango, Portville, N. Y.; very fossiliferous strata one mile east of Stoneham, Pa. (Venango First Oil Sand); east of Cobham, Pa., between the Olean and Sub-Olean; Stone Hill near Stoneham, Pa. throughout the Conewango: Conewango, two miles northwest of Warren, Pa.; Conewango at Kinzua, Pa.; many places near Bradford, Pa., in the Conewango; top of Robin's Hill on the Onoville road, one mile east of the Cattaraugus Co. line, N. Y., about 300-500 feet above the Pope Hollow conglomerate; white sandstone at base of the Olean conglomerate on the hill south of Smethport, Pa.; Oswayo beds at a rock cut along a spur railroad track going west, about two miles from Smethport.

ATHYRIS

Athyris angelica Hall — **Plate 9.**

Athyris angelica Hall, 14 Rep. N. Y. S. Cab. Nat. Hist., 1861, p. 99.
Athyris angelica Hall. 15th Rep. **ibid.** 1862, pl. 3, figs. 10-13, 24.
Athyris angelica Hall. Pal. N. Y. IV, 1867, p. 292, pl. 47, figs. 9-20.
Athyris ? polita Hall. Pal. N. Y. IV, 1867, p. 293, pl. 47, figs. 21-23.
Athyris angelica, Walcott. Mon. U. S. Geol. Surv. VIII, 1884, p. 148.
Meristella (?) incerta Simpson. Tr. Am. Phil. Soc. 16, 1890, p. 442, fig.
Athyris angelica, Hall and Clarke, Pal. N. Y. VIII, pt. II, 1893, p. 90, pl. 45, figs. 26-30.

[26]See. Schuchert, C. "On the Brachiopod Genus Syringothyris in the Devonian of Missouri". Am. J. Sc. 30, 1910, p. 223.
Girty, G. H., "On the Genus Syringopleura, Schuchert". Journ. of Geol., 1911, p. 594.

Shell usually with a sub-pentagonal outline, lateral margins the longest; usually widest below the middle; usually globular in appearance, the ventral valve being the more gibbous. Length usually greater than width.

Ventral valve largest, most gibbous posteriorly, with a well defined rounded sinus which begins early on the beak and extends forward in a linguiform extension which varies in the degree of development in individuals. Strong cardinal teeth are supported by anteriorly diverging dental lamellæ which extend anteriorly about three-fourths the length of the posterior median elevation of the mold. The beak is incurving and internally bears well defined muscular impressions. These have been well described by Hall (Pal. of N. Y., vol. IV, p. 292). Great variation in these impressions exists in the specimens examined. One common variation is a large humped anterior area of the mold of the muscular impressions. No vascular impressions were noticed. The cardinal area is short.

The dorsal valve is usually much shorter, the length and width more nearly equal. Mesial fold usually well developed, especially in the anterior half of the shell. It extends forward in proportion to the mesial sinus. The muscular impressions are usually absent. Area practically absent. Well defined dental sockets are present on either side of the low umbo. The impression of an elongate, low median septum is usually present in the internal mold.

The surface in unexfoliated specimen is well marked by concentric striæ which become lamellose at times toward the front of the shell. The entire surface bears interrupted radiating lines which are usually best developed on the sides. These give the surface of well preserved specimens a peculiarly textile-like appearance. This is particularly noticeable on specimens upon which each of the radiating striæ is slightly thickened anteriorly where it meets a varix. In some, the situation is such that each varix has the appearance of a series of small nodules. There are five striæ to a millimeter usually, with slight deviations.

In partially or entirely exfoliated specimens the short interrupted striæ are absent and in their stead there appear radiating uninterrupted striæ, usually best developed mesially[27]. These radiating striæ are normally coarser than the external ones and

[27]Walcott, Mon. U. S. Geol. Surv. VIII, 1884, p. 148.

it is only occasionally that they are fine enough to give the molds a fenestrated appearance.

Dimensions:

Length.....24, 27, 23, 22, 20 mm., ventral
Width .....23, 25, 24, 21, 23, 20 mm., both valves
Length .....20, 11, 27, 18, 19, 22 mm. dorsal (not necessarily the same specimens as the above.)

All of the specimens of *Athyris* collected in the Bradfordian of western N. Y. and Pa. were referred to this species. The only character of those from the upper beds which might possibly be regarded as varietal might be their more constant transverse condition as contrasted with the more constant globular condition of those in lower beds. However, both phases occur wherever the species is found.

We are referring the species *Meristella* (?) *incerta* Simpson to *Athyris angelica* Hall largely on his description and figures. We have been unable to see the types of *M. incerta.* Among many specimens collected in the environs of Warren in the Waverly beds, which are probably the type locality for Simpson's 'species', we have many specimens which closely approach those pictured by him. We also have many almost perfect specimens, with even the delicate surface markings intact. Using the poorly preserved and crumpled material such as he pictures in his description true identification would be difficult, but average material quite certainly points to *A. angelica. A. polita* may be a good species but from all of Hall's descriptions and illustrations it seems to be based on individuals of *A. angelica* which gradate, as do many other erratic individuals, with the mass of the species. For the time being, at least, we are considering these species synonymous.

The upper Chemung *Athyris* and especially those from the Venango First Oil Sand horizon have frequently a close approximation to the Mississippian and Carboniferous *Composita.* From the decalcified specimens, the only ones obtainable, this seeming resemblance is at present based exclusively on superficial characters.

Occurrence.—Three miles southeast of Stoneham, Pa., in the Waverly beds, the formation referred to as Cuyahoga by Ver-

wiebe[28]. The stratum is very fossiliferous though this species is only moderately common. It is a light gray sandstone which weathers to a buff color. It is stratigraphically just above the Sub-Olean conglomerate.

Associated with this species were *Spirifer disjunctus, Spirifer allegheniensis, Camerotœchia contracta* and *C. sppho, Syringothyris angulata, Cyrtina triplicata, Platyceras, Euomphalus,* etc.

Collections were also made in various places in the Bradfordian of Cattaraugus county, N. Y., for comparison. The specimens were also compared with material in the Geological Museum at Cornell University.

James Hall described *A. angelica* from the Chemung beds at Phillipsburg, Rockville, Great Valley, Randolph, Cadiz, N. Y., and at Meadville, Pa. His species *A. polita* came from practically the same localities in southwestern N. Y.

Athyris lamellosa (L'Eveillé) Plate 11, figs. 22, 23.

Athyris lamellosa Meek, Pal. of Ohio, II, 1875, p. 283, pl. 14, fig. 6., Hall Pal. of N. Y., VIII, II, 1893, p. 90, pl. 46, figs. 16-20.

This is a Waverlian species described from Ohio strata at Sciotoville, O. It has been reported by J. F. Carll from Titusville, Pa., in vol. 4, 2nd. Pa. Geol. Surv., p. 293.

AMBOCŒLIA

Ambocœlia gregaria Hall Plate 11, figs. 24-27

Ambocœlia umbonate var. gregaria Hall, Pal. of N. Y., IV, 1867, p. 261, pl. 44, figs. 19-25.

"The ventral valve is often more elongated than *A. umbonata* and the margins of the mesial sinus are sub-angular. The dorsal valve is depressed convex with a distinct median sinus... The casts of the interior of the ventral valve show a longitudinal median crest in the muscular impression, which is often also limited at the sides by a linear, obtuse impressed line, as if by some callosity on the interior of the shell."—Hall.

The species is usually small and practically never reaches more than half an inch in diameter, and this size rarely.

Occurrence.—In western N. Y. this species is found near Randolph, New Albion and Conewango, etc. It is a characteristic upper Chemung species.

[28]Verwiebe, Am. Journ. of Sci., 18, April 1917.

RETICULARIA

Reticularia præmatura (Hall) Plate 11, figs. 4, 5.

Spirifer Præmatura Hall, Pal. of N. Y., 1867, p. 250, pl. 33, figs. 31-35.

Shell ovate or orbicular, hinge-line shorter than the width of the shell; the cardinal angles rounded; surface decoration consisting of sub-imbricating concentric striæ and coarser radiating striæ. The surface is not plicate, and is sometimes almost pustulose.

The ventral valve has a broad shallow sinus which is poorly defined. The beak is slightly elevated and incurved; area small, not defined.

The dorsal valve is regularly and moderately convex with only a slightly defined mesial fold.

Occurence.—In the 'Chemung group' at Meadville, Pa., and Oil Creek, Pa., and in the beds referable to the Venango First Oil Sand (lower Carboniferous) at Stoneham, Pa., just east of the monument and in a coarse sandstone just below the Sub-Olean conglomerate on the west side of Robin's Hill along the main highway. This is probably the same horizon as at Stoneham, Pa. It is associated with *Spirifer disjunctus, Chonetes, Productella*, etc.

RHYNCHOSPIRINA

Rhynchospirina scansa (Hall) Plate 11, figs. 3, 15, 16.

Plate 13 figs. 1-7.

Rhnychospira scansa Hall Pal. of N. Y., VIII, II, 1895, pl. 50, fig. 45. 14th. Rept. N. Y. State Geol. 1894. p. 360, pl. 9, fig. 2.

Pedicle valve large, with prominent, somewhat arched beak; cardinal slope extending about one-half the length of the shell; outer margin semi-oval; surface with sharply defined median furrow which usually bears a single small plication; the lateral slopes have eight or ten rounded broad plications.

The pedicle valve also has a very large apical aperture. This is the most outstanding feature of all the specimens examined. The median furrow is occasionally obsolete.

The brachial valve is more gibbous and shorter than the pedicle valve. The internal mold of the brachial valve shows strong dental impressions and the imprint of an almost obsolete median septum. The median costa of the brachial valve is most frequently larger than any of the lateral costæ.

Occurrence.—Originally described from the 'Waverly' of Mc-

Kean county, Pa., and reported by C. Butts from the Oswayo of the Olean region. This species has been found in great abundance in the chocolate Oswayo shales two miles west of Smethport, Pa., in a rock cut on a spur railroad. It commonly occurs as internal molds of one or both valves and is usually badly crumpled.

Rhynchospirina ? sp. **Plate 11, figs. 9-14.**

In the sandstone of the Venango First Oil Sand horizon on Stone hill near Stoneham, Pa., is found a very small, multiplicate rhynchonelloid shell which might be referred to *Retzia* or *Rhynchospirina*. The specimens all consist of internal molds and external casts. The shell is posteriorly attenuate and anteriorly usually globular. The number of plications varies from about sixteen to nearly tewnty-five. The illustrations are slightly enlarged.

PELECYPODA

AVICULIPECTEN (*)

Aviculipecten tenuis Hall **Plate 32, figs. 7, 8, 9.**

Pal. of N. Y. Vol. V, I, 1884, p. 39, pl. 81, fig. 6; pl. 7, figs. 27-28.

Occurrence.—In the calcareous sandstone of the 'Upper Chemung' group at Randolph and Salamanca, N. Y.

Avoculipecten duplicatus Hall **Plate 33, figs. 6-10.**

Pal. of N. Y., Vol. V, I, 1884, p. 17, pl. 7, figs. 1-7; pl. 81, figs. 9, 10.

Occurrence.—In the 'Chemung group' at Rockville, Hobbieville, Phillipsburg, East Randolph, N. Y., etc.

Aviculipecten ellipticus Hall **Plate 32, fig. 1.**

Pal. of N. Y., Vol. V, I, 1884, p. 25, pl. 7, fig. 31.

Occurrence.—In the sandstone of the 'Upper Chemung' at Meadville, Crawford county, Pa.

Aviculipecten celsus Hall **Plate 32, figs. 2, 3.**

Pal. of N. Y., Vol. V, I, 1884, p. 23, pl. 7, figs. 29, 30.

Occurence.—In the sandstone of the conglomerate associated with the 'upper Chemung' at Salamanca, N. Y.

Aviculipecten striatus Hall **Plate 32, figs. 4,6. Plate 31, figs. 2-5.**

Pal. of N. Y., Vol. V, I, 1884, p. 22, pl. 10, figs. 3, 4.

Occurrence.—In the middle Chemung at Painted Post and Chemung Narrows and in the Chemung at Warren, Pa. Common in the sandstones immediately below the outcropping conglomerate at Stickley, Pa. (See Plate 31.)

***Note: Orthography fide Girty.**

Aviculipecten æquilateralis Hall Plate 32, fig. 10
Plate 31, fig. 1.

Pal. of N. Y., Vo. V. I, 1884, p. 19, pl. 82, fig. 1.

Occurrence.—In the upper beds of the 'Chemung group' at Allegany Sulphur springs, Warren county, Pa. Specimens very close to this species have been taken in the Conewango formation two miles northwest of Warren, Pa.

Aviculipecten patulus Hall Plate 33, figs. 1, 2.

Pal. of N. Y., Vol. V, I, 1884, p. 24, pl. 7, figs. 32, 33.

Occurrence.—In conglomerate and sandstone associated with the upper 'Chemung group' at Rock City near Sa'amanca, N. Y. Reported by C. Butts from the Wolf Creek and Salamanca conglomerates[29].

Aviculipecten cancellatus Hall Plate 33, figs. 3, 4, 5.

Pal. of N. Y., Vol. V, I, 1884, p. 18, pl. 7, figs. 12, 14-19.

Occurrence.—In the middle members of the Chemung group as exposed at Phillipsburg and Rockville, Allegany county, N. Y., and at Conewango and near Westfield, N. Y.

Aviculipecten æquilata Simpson Plate 32, fig. 5.

Tr. Am. Phil., Soc. n. s. 16, 1890, p. 445. il.

Occurrence.—In the 'Chemung group' north of Warren, Pa.

LYRIOPECTN

Lyriopecten solox Hall Plate 33, fig. 11.

Pal. of N. Y., Vol. V, I; 1884, p. 56, pl. 25, fig. 5.

Occurrence.—In a fine grained calcareous argillaceous sandstone (lying above the Panama conglomerate) of the upper 'Chemung group' near Panama, N. Y.

Lyriopecten fasciatus Hall Plate 35, figs. 1, 3.

Pal. of N. Y., Vol. V, I, 1884, p. 55, pl. 9, figs. 10, 11.

Occurrence.—In the Chemung group at Leon, Cattaraugus county, N. Y.

Lyriopecten alternatus Hall Plate 32, fig. 6.

Tr. Am. Phil, Soc, ns. 16, 1890, p. 446. il.

Occurrence.—In the 'Chemung group' at Warren, Pa.

PTERINOPECTEN

Pterinopecten suborbicularis Hall Plate 34, figs. 1, 2, 4, 9.

Pal. of N. Y., Vol. V, I, 1884, p. 80, pl. 8, figs. 1, 2; pl. 24, fig. 10; pl. 82, fig. 6.

Occurrence.—In the 'Chemung group' at Hobbieville and Lit-

[29]Bul. N. Y. State Mus. no. 69, p. 994.

tle Valley, and New Albion, N. Y. It is also found at Mansfield, Pa. Butts found this species above the Salamanca conglomerate[30].

CRENIPECTEN

Crenipecten amplus Hall — **Plate 34, fig. 3.**

Pal. of N. Y., Vol. V, I, 1884, p. 81, pl. 9, figs. 9, 13, 18.

Occurrence.— In the shales of the Chemung group at Rockville, Allegany county, N. Y.

Crenipecten crenulatus Hall — **Plate 34, figs. 3, 8.**

Pal. of N. Y., Vol. V, I, 1884, p. 82, pl. 9, figs. 6-8, 15-17.

Occurrence.—In the shales of the 'Chemung group' at Rockville, Allegany county, N. Y.

Crenipecten impolitus Hall — **Plate 34, fig. 5.**

Pal. of N. Y., Vol. V, I, 1884, p. 83, pl. 9, fig. 14; pl. 83, fig. 10.

Occurrence.—In a coarse sandstone of the 'Chemung group' near Olean, Alleghany county, N. Y.

Crenipecten micropterus Hall — **Plate 34, fig. 6.**

Pal. of N. Y., Vol. V, I, 1884, p. 86, pl. 9, fig. 23.

Occurrence.—In the shales of the 'Chemung group' at Phillipsburg, Alleghany county, N. Y.

Crenipecten liratus Hall — **Plate 35, figs. 7, 8.**

Pal. of N. Y., Vol. V, I, 1884, p. 87, pl. 19, fig. 24; pl. 83, fig. 9.

Occurrence.—In the 'Chemung group' at East Randolph, N. Y.

Crenipecten winchelli Hall — **Plate 36, figs. 1-3.**

Pal. of N. Y., Vol. V, I, 1884, p. 89, pl. 9, figs. 1-2, 4, 25-30.

Occurrence.—In the Waverly sandstone of Newark, Ohio. In the Bedford shales of Ohio according to G. Girty[31] and in the Salamanca conglomerate according to C. Butts[32].

Crenipecten leon Hall — **Plate 35, figs. 4, 5.**

Pal. of N. Y., Vol. V, I, 1884, p. 88, pl. 9, fig. 12; pl. 83, fig. 8.

Occurrence.—In the sandstone of the 'Chemung group' at Leon, Cattaraugus county, N. Y.

LEPTODESMA

Genotype: **Leptodesma rogersi** Hall[33]

The genus Leptodesma differs essentially from *Leiopteria* in the acuteness of its anterior cardinal angle and the absence of a lobate ear. The hinge is narrow and bears a small lateral tooth just behind the beak and nearly parallel to the hinge line. The

[30]Bull. N. Y. State Mus. No. 69 p. 994.
[31] N. Y. Acad. of Sc. 22, p. 307.
[32]Bul. N. Y. State Mus. No. 69, p. 994.
[33]See Clarke, J. M. "Composite Generic Fundamenta" Am. Geol., Vol. 13, 1894, p. 286.

ligament is external and the area extends the entire length of the hinge line and is longitudinally striate. The surface bears concentric growth lines.

The genus *Leptodesma* is probably one of the best known of all the Pelecypod genera occurring in the upper Chemung and Waverly groups of western New York and northwestern Pennslyvania.

The variations of this genus might be termed the Paleozoic counterpart of our recent *Unionidæ*. It is now very difficult to make any specific determinations in this genus and the problem will grow in complexity so long as individual specimens constitute a species and intermediate forms are unknown. The problem at hand is not to attempt to point out other than obvious relationships, but is rather to bring together most of the forms described from this particular region and show what few new forms have been discovered. The true value of the many species and varieties must await someone with much larger collections and a 'monographic complex.'

Of the more than fifty species of *Leptodesma* described by James Hall about seventeen are discussed herein. All of these have been described from the upper Chemung (including Conewango) and Waverly groups of northwestern Pa. and N. Y., or else they have been reported from these horizons.

Where possible the type specimens have been studied and in many of the specific discussions the original descriptions have been largely incorporated.

Leptodesma myiliforme Hall

Plate 24, fig. 2
Plate 40, fig. 9.

Leptodesma mytiliforme Hall, Pal. N. Y., Vol. V, pt. II, 1883, p. 235, pl. 25, figs. 7, 11.

Description from Hall:

Shell of medium size elongate-ovate; body narrowly elliptical, becoming attenuate in front, oblique, making an angle of nearly 45 degrees with the hinge-line; length more than one-third greater than height; ante-byssal margin oblique, gently curving into a scarcely perceptible sinus. This gives a slightly concave or straight margin which extends for two-thirds the length of the valve; posterior margin rounded.

Left valve regularly convex in the lower half, becoming contracted gibbous and subangular above the middle. The right valve is smaller, the hinge-line proportionately longer, the base of the valve and the wing much more depressed, and the umbonal region narrow and more angular.

Hinge-line straight and about equal to the height of the valve.

Beaks sub-anterior, directed forward, acute, scarcely rising above the hinge-line. Umbonal region narrow and gibbous, subtending a very acute angle.

Anterior end short, abruptly attenuate, acute, limited by a shallow byssal depression which extends for half the length of the valve. Wing large, not strongly limited, extending nearly to the posterior extremity of the body; margin very oblique, not concave, nor recurved below the cardinal line.

The surface marked by concentric striæ which are crowded into fasicles on the anterior side.

The illustration of the type specimen of this species is natural size.

Occurrence.—The specimens came from what was Hall's type locality in a coarse-grained sandstone, which in places approaches a conglomerate, along the road from Smethport to Olean. The outcrop is about one-eighth of a mile out of Smethport. The sandy layers are stained a rusty brown and all the fossil molds or casts are covered with a coat of rust. Associated with L. *mytiliforme* were many *Orbiculoidea* and Spirifers.

Leptodesma disparile Hall Plate 22, figs. 7, 8, 9, 10, 11.
Pal. of N. Y., Vol. V, I, 1884, p. 186.

Shell small to medium in size; body ovate, oblique to hinge at about 45 degrees. Ante-byssal margin oblique; basal and posterior margins regularly rounded.

Left valve convex below, gibbous above; right valve flat or concave below, slightly convex in the middle and gibbous on the beak.

Hinge-line straight and greater than the length of the shell.

The beak is elevated a little above the hinge-line and extends slightly forward.

The wing bears an elongate spine. The hight valve is smaller than the left and the wing is more extended and less defined, while the large anterior end is well defined by a byssal sinus.

The surface bears concentric lamellose ridges with finer lines of growth between them.

The large anterior end, narrow umbo, large and extended wing, and only slightly sinuate anterior margin characterize the species.

Occurrence.—The type specimens of this species come from a coarse sandstone of the 'Chemung group' in McKean county, Pa., and Cattaraugus county, N. Y. The matrix in which they are embedded is identical with the Sub-Olean conglomerate, blocks of which are common at Smethport, Pa., just under the Olean con-

glomerate on the hill south of the town at what is locally known as 'The Devil's Den'.

Leptedesma potens Hall Plate 21, figs. 1, 4, 5, 6, 7, 9.

Pal. of N. Y., Vol. V, I, 1884, p. 188 Plate 41, fig. 3.

The members of this species are among the largest Leptodesmas found commonly in the upper Chemung.

The shell is sub-rhomboidal; body ovate, oblique, broad below; length more than one-third greater than the height. Anterior margin is sub-truncate; basal margin curving.

Valves about equally convex; right valve shorter and wider than the left and slightly more gibbous on the umbo.

The straight hinge is the greatest length of the shell.

Beak sub-anterior, elevated, curving over the hinge-line. Wing large and triangular bears a spine terminally; separated from the umbo by an abrupt, even, subangular slope. Anterior byssal portion of the shell rather small, angular in front and separated from the umbo by a poorly defined depression.

Surface with concentric growth lines which become fasciculous at intervals and are lamellose in front.

The illustrations of the type specimens are natural size.

This species is closely related to *L. mortoni* Hall.

Occurrence.—Upper Chemung at Olean, Portville, and East Randolph, N. Y.

Leptodesma potens, var. juvens Hall Plate 21, fig. 5.

Pal. of N. Y., Vol. V, I, 1884, p. 189.

While this variety is more extended and more acute in front than the typical *L. potens* it is quite possible that it is only an immature form of that species as Hall intimated when he described the variety.

The illustration of the type specimen is natural size.

Occurrence.—The same as for *L. potens* Hall.

Leptodesma becki Hall Plate 22, fig. 17

Pal. of N. Y., Vol. V, I, 1884, p. 185.

This species was originally described by Hall from the Middle Chemung beds at Corning, N. Y., with a possible specimen of this species from the Chemung in Cattaraugus county, N. Y. It is this latter specimen in which we are interested. This specimen probably does not belong to the species *L. becki* Hall. There is

no good evidence for a spinous extremity to the wing as is characteristic *L. becki*. The posterior margin is nearly straight instead of slightly concave. In addition to these characters this specimen has an alar furrow and fold as well developed as in *Ptychopteria*. In fact the whole appearance of the specimen is that of a smooth Ptychopteroid form. It probably occurs below the Conewango formation which is characterized by true Ptychopteria.

The species *L. becki* probably is limited to the middle Chemung and except for this one specimen seems to have never been recorded from the upper Chemung.

Leptodesma umbonatum, var. **depressum** Hall Plate 22, figs. 4, 5.

Pal. of N. Y., Vol. V, I, 1884, p. 199.

Shell of medium size, rhomboidal; body very oblique. ovate; length once and a half greater than the height; ante-byssal margin regularly curving into the ventral margin which is broadly rounded and posteriorly recurved.

Left valve convex below, gibbous above. Right valve smaller, a little less convex, abruptly gibbous on the umbo.

Hinge-line straight, somewhat less than the greatest length of the shell. Beaks sub-anterior, obtuse, directed forward slightly, very prominent, and arched over the hinge-line.

Anterior end short, large, limited by a broad, poorly defined depression; acute in front. Wing large and triangular not clearly separated from the umbo; termination acute but not attenuate.

Surface marked with concentric striæ which regularly fasciculate on the body and become lamellose anteriorly.

The illustrations of the type specimen are natural size.

The species *L. umbonatum* of which we have no specimens at hand, is more convex, and narrower in the lower part of the body and has a pronounced anterior sulcus. The posterior slope is less elevated and the ante-byssal portion of the shell is larger.

Occurrence.—Upper Chemung at Napoli Center, Cattaraugus county, N. Y. This is quite probably a Conewango species.

Leptodesma stephani Hall Plate 22, figs. 12, 14, 15.

Pal. of N. Y., Vol. V, I, 1884, p. 194. Plate 41, fig. 2.

Shell larger than medium forms of the genus. Post umbonal

slope nearly straight, obliquity with the hinge-line about 30 to 40 degrees. Ante-byssal margin truncate above, curving below into a sinus.

Left valve slightly larger and more gibbous in the umbonal portion than the right valve.

Hinge-line straight and equals nearly the length of the valve.

Beaks sub-anterior and directed forward, obtuse, prominent, elevated slightly above the hinge-line.

Anterior end large, short and defined by a nearly vertical byssal depression. Wings large and ending in a spine. Rear margin concave above and convex below.

Shell of average thickness, externally marked by lamellose concentric varices which differ in size and are best devleped toward the front of the shell.

To this species probably belong *L. billingsi* Hall and *L. curvatum* Hall.

The illustrations of the type specimens are natural size.

Occurrence.—Upper Chemung at Bradford, Pa.

Leptodesma mortoni Hall Plate 22, figs. 1, 2, 3.

Pal. of N. Y., Vol. V, I, 1884, p. 190.

Shell larger than medium, body elongate, ovate, oblique; posterior margin extended and abruptly recurved.

NOTE:—

Among the type specimens of **L. curvatum**, **billingsi** and an incomplete specimen of **L. stephani** great similarity exists The only differentiating character is the slight difference in the size of the ante-byssal portions of the shells. **L. stephani** has the larger anterior; this portion is smaller in **L. billingsi** and smallest in **L. curvatum.**

The species **L. curvatum** is based on a badly eroded specimen from which the surface markings are almost absent and the extremity of the wing is absent. The type also appears to have undergone crushing in the process of presevation. While **L. Curvatum** and **L. billingsi** may be specifically different their characteristics seem to depend on mechanical rather than biological forces.

The resemblance of **L. billingsi** to **L. stephani** is very great as the illustrations (Pl. 14, figs. 6, 12, 15,) show.

It seems almost futile to try to establish a species of such fragile things as these Paleozoic aviculoids on one or two specimens and these very imperfect. The characterization of such a species must at best depend in some degree upon a hypothetical form constructed from the fragments which all too often fail to substantiate the hypothesis.

L. billingsi was found by Hall in the Chemung beds at Panama, N. Y., and **L. curvatum** in the "Sub-Olean" sandstone near Smethport, Pa.

Left valve larger than right; convex below and more gibbous above. Right valve slightly convex below and abruptly gibbous on the umbo.

Hinge-line straight and less than the height of the shell.

Beaks nearly anterior, erect, prominent, arching over the hinge-line.

Anterior end acute and nasute; wing large and triangular; margin slightly convex. Posterior margin concave, extremely produced and very acute.

Right valve slightly smaller than left but otherwise very similar.

The surface is concentrically striate, the striæ becoming fasciculate in places and giving the surface a somewhat undulating appearance.

Illustrations of type specimens natural size.

The pictures shown are from a very poor type specimen and this particular one more closely resembles *L. potens* than other specimens of the species *L. mortoni* described and pictured by Hall. In fact the similarity between all of the type specimens of *L. potens* and *L. mortoni* is rather close.

Occurrence.—The Chemung group at Portville, and Little Genesee, Alleghany county, N. Y. This is probably found only below the Conewango in the true Chemung.

Leptodesma matheri Hall Plate 21, figs. 11, 12.
Pal. of N. Y., Vol. V, I, 1884, p. 190.

Shell of medium size, approximately rhomboidal; body oblique, meeting the hinge-line at about 45 degrees. Ante-byssal margin vertical; length about one-half greater than the height.

Left valve moderately convex below and scarcely gibbous above; right valve shorter and less convex.

Hinge-line straight; its entire length about equaling the height of the shell.

Beaks at about anterior third of the shell; obtuse, directed forward, not prominent.

Anterior end of moderate size, produced and apically acute. Wing not large with the extremity nearly right-angled. The posterior margin is slightly concave; the wing is separated from the body by a very abrupt post-umbonal slope.

Shell thin, marked by fine concentric striæ which are spaced about equidistant on the body but are fasciculate on the anterior.

The illustrations of the type specimens are natural size.

Occurrence.—Upper Chemung beds at Bradford, Pa.

Leptodesma mentor Hall — Plate 21, figs. 10, 14.

Pal. of N. Y., Vol. V, I, 1884, p. 205. — Plate 24, fig. 5.

Medium sized shell, sub-rhomboidal; body elongate, ovate, narrow at anterior end, oblique, meeting the hinge-line at about 40 degrees. Length one-third greater than height. Ante-byssal margin subtruncate, curving gradually into a sinus which separates the anterior portion of the shell from the umbo.

Left valve moderately convex in the lower part, becoming more convex in the middle and gibbous above.

Hinge-line straight and equal to the height of the valve.

Beak sub-anterior, forward pointing, acute, elevated only slightly above the hinge-line. Umbonal region very narrow, well elevated and with precipitous sides. Ante-byssal portion of the shell of average size and with an acute anterior.

Wing well defined by a shallow groove, though this is occasionally absent. Rear margin oblique, and slightly concave just below the cardinal line.

Shell thin and marked by undulating concentric growth lines which are regularly fasciculous.

Illustrations of the type specimens are natural size.

The species *L. mentor* or some closely allied form of its general appearances seems to have been the mean of great variation in the time represented by the Sub-Olean sandstone of this region in western N. Y. and Pa. It seems that an almost infinite number of variations of this one type are present in these sandstones. While they probably developed along regular lines the few widely separated forms that have been found seem almost specifically different from their associates, and as distinct species many of these have been differentiated in the past. While the precise determination of the standing of the species, if it is ever made, must await the coming of someone with an exhaustive curiosity and a monographic *penchant*, we are referring the most obviously variational

forms to the species *L. mentor* giving some specimens, where it seems advisable, variety ranking.

Occurrence.—South of Smethport, Pa., in McKean county, Pa. The horizon is probably Sub-Olean, for this is probably the coarse sandstone Hall referred to in his original description. All of our specimens come from that horizon.

Leptodesma mentor, var. orodes Hall **Plate 21, figs. 8, 13, 15.**

Leptodesma orodes Hall, Pal. of N. Y., Vol. V, I, 1884, p 206.

This variety differs from *L. mentor* by being less oblique, with a slightly less attenuate body, and a wing which is indistinctly delimited by an alar furrow. The furrow when present in *L. mentor* is usually very well developed but is frequently absent. The sides of the shell are more nearly parallel in *L. mentor orodes* than in *L. mentor.*

The type specimens of Hall's species *L. mentor, orodes and beckii* all show evidences of an alar fold and furrow; on some of the specimens these are very similarly located to the same in *Ptychopteria.*

Illustrations of the type specimens natural size.

Occurrence.—Associated with *L. mentor* in the Sub-Olean sandstone between Olean, N. Y., and Smethport, Pa.

Leptodesma mentor, var. biton Hall **Plate 22, fig. 18.**

Leptodesma biton Hall, Pal. of N. Y., Vol. V, I, 1884, p. 222.

This variety differs from *L. mentor orodes* by having a more acute anterior extremity and by having a larger wing which is distinctly concave on the margin. *L. mentor biton* is also larger than the true types of *L. mentor orodes.* (The one exception being a badly crumpled specimen of *L. mentor orodes.* Pl. 50, fig. 15).

The concavity of the wing of *L. mentor biton* is probably only the slight concavity seen on the wings of *L. mentor orodes* magnified by growth. The one real difference between *L. mentor orodes* and *L. mentor biton* is the slightly greater extent of the forward part of the shell in *biton.*

Occurrence.—The Sub-Olean conglomerate or sandstone near Smethport, McKean county, Pa.; associated with the other forms of *L. mentor.*

Leptodesma mentor var. maclurii Hall **Plate 22, fig. 13.**

Leptodesma maclurii Hall, Pal. of N. Y., Vol. V, I, 1884, p. 228.

This variety is of the general *L. mentor biton* shape with the *L. menton* alar furrow and well defined byssal sinus developed still further, especially in the right valve. While this is probably not a good variety, evidence is insufficient at present to refer it to synonymy under any of the other varieties or species.

Occurrence.—Associated with *L. mentor* var. *biton* in the sandstones at Smethport, Pa.

Leptodesma mentor, var. rude Hall **Plate 21, fig. 8.**

Leptodesma rude Hall, Pal. of N. Y., Vol. V, I, 1884, p. 221.

Shell large, subrhomboidal, body ovate below and rapidly attenuating above. Umbo and hinge-line meet at about 50 degrees. Ante-byssal margin sub-truncate, curving into a broad sinus; ventral and posterior margins broadly rounded.

Left valve convex below, narrower and gibbous above. Right valve less convex. Hinge-line straight.

Beak in anterior third of the shell, slightly elevated.

Anterior portion large, limited by a nearly vertical byssal depression; wing rather small, demarked by an indistinct sulcus; termination acute as indicated by the outward swing of the growth lines.

Shell evidently thick, marked by concentric varices which become decidedly lamellate and leave strong impressions on the internal molds. "These surface markings are subdued in the right valve".

The illustration of the type specimen is natural size.

The coarse irregular appearance of this shell seems to be the characterizing features. It is probably not a good variety but until a good intermediate series can be formed it must stand. It probably is only another individual variation of the *L. mentor* gens.

Occurrence.—The Sub-Olean sandstone at Smethport, Pa., which is characterized by the *L. mentor* gens.

Leptodesma mentor, var. sulcata n. var. **Plate 23, fig 2**
Plate 24, fig. 7.

Shell large; hinge-line straight. Anterior byssal margin nearly

truncate, broadly rounding below into the byssal sinus; basal margin broadly rounded. Rear margin convexo-concave, sigmoidal. Posterior alar extremity unknown, though evidently not attenuate.

Wing elongate triagonal, of medium size, demarked from the gentle post-umbonal slope by a usually well defined sulcus. Ante-byssal portion of average size, separated from the steep anterior umbonal slope by a definite byssal sinus.

Right valve slightly smaller than the left with the byssal sulcus usually better developed and alar sulcus less evident.

Body elongate; basally ovate; apically nearly acute. Body regularly convex basally, gibbous anteriorly. Beak slightly elevated, forward pointing and not extending over the hinge-line.

Surface concentrically lamellate. The ante-byssal portion of the shell usually with well-developed concentric striæ which are fasciculous or imbricating.

This variety most closely resembles *L. mentor biton* in shape and general character of the left valve though *L. mentor sulcata* is larger and with a well-developed alar furrow. The right valve is quite similar to the same valve of Hall's *L. macluri*, both having the byssal sinus very well developed. *L. sulcata* is much larger and has a greater posterior length. It differs from the species described by Simpson[34] as *L. leiopteroides* in that the sulcus is more pronounced and the ante-byssal portion of the shell in *L. m. sulcata* is much larger.

Dimensions.—Hinge-line app. 47 mm.; 38 mm.; anterior length about 55 mm.; 50 mm.; posterior length about 37 mm.; 32 mm. These are for left valves. The right valve is slightly smaller but the one attached specimen is too imperfect to permit measurements.

The specimen illustrated on Plate 24, fig. 7, may prove to be a separate variety; the body is considerably narrower and the beak less elevated above the hinge-line, and the hinge-margin more sinuate.

Occurrence.—The Sub-Olean sandstone at Smethport, Pa., at what is locally known as the 'Devil's Den', and in the Oswayo formation one mile east of Mt. Jewett, Pa., on the road to Smethport, Pa.

[34]Simpson, G. B. Tr. Am. Phil. Soc. N. s. Vol. 16, 1888, p. 447, il.

Leptodesma mentor, var. maxima n. var. Plate 24, fig. 1, 4, 6. Plate 23, fig. 4.

Shell large, moderately oblique; hinge-line straight and nearly equal to the posterior length. Ante-byssal margin truncate, rounding into a broad sinus. Anterior margin continues almost straight to the base which is narrowly rounded. Posterior margin slightly undulating, little convex immediately below the cardinal line. Posterior extremity, unknown but the growth lines suggest a slight acuteness.

Regularly convex basally, arched mesially and gibbous anteriorily. The umbo is prominent and slightly elevated above the cardinal line.

Wing and ante-byssal portions large, the former undefined and the latter well defined.

The surface is marked by concentric varices of growth which are best developed marginally and anteriorly.

The right valve is considerably smaller and has a larger ante-byssal portion than the left valve.

Hinge-line 46, 37 mm.; front margin 55, 42 mm.; rear margin 35, 33 mm.; no perfect right valve is known.

This is probably closely related to the new variety *L. mentor sulcata* though the differences are sufficient on the present criterja to separate them.

Occurrence.—Sub-Olean sandstone on the hill southeast of Smethport, Pa. Associated with the other forms of *L. mentor.*

Leptodesma mentor, var. alpha n. var. Plate 24, fig. 2.

Shell large, oberect. Lateral margins nearly parallel; base well rounded; hinge-line straight; front angle acute but not attenuate; posterior angle slightly attenuate. Anterior margin almost straight or only slightly convex with a slight concavity at the base of a small ante-byssal portion. Posterior margin convex basally and slightly concave as it nears the hinge-line. Concentric striæ well developed anteriorly and near the periphery of the shell at the basal and posterior-basal portions.

The front umbonal slope is very short and sharply declining, posterior slope more gradual and undifferentiated from the rather large wing.

The dimensions of the shell are: Hinge-line app. 31 mm.; rear margin 35 mm.; front margin about 45 mm.; distance from beak

to base along the umbonal ridge about 52 mm.

This shell has much in common with *L. mentor,* var. *orodes* Hall, especially in the nearly parallel condition of the sides of the shell. The variety *alpha* is much larger than any described forms of the variety *orodes.* While this form is sufficiently different to have variety rank according to the established criteria for this genus, it may later be shown to be an adult or over-developed form of *orodes* or some closely allied form.

Occurrence.—Oswayo formation one mile east of Mt. Jewett, Pa., on the road to Smethport, Pa. This was associated with *L. carinifera.*

Leptodesma ruedemanni n. sp. **Plate 23, fig. 4.**

Shell triangular in outline, large. Hinge-line straight; posterior margin nearly straight, with a very slight concavity near the middle of the wing. Posterior margin meets the hinge-line at about 85 degrees. The posterior basal angle is sharply rounded. The basal anterior margin is sharply recurved into the anterior margin which is nearly straight to the byssal sinus. Little of the margin is known beyond this point, though the evidences point to a well-defined and relatively large ante-byssal portion of the shell.

Shell regularly convex below and arcuate above. The umbo is probably the most gibbous portion of the shell. The anterior umbonal slope is abrupt and narrow; the posterior slope wide and gentle; continues with almost a constant gradient on to the wing which is large and triangular and undefined.

Species known only from a single right valve.

The surface of the internal mold is nearly smooth with weak concentric growth lines showing on the anterior umbonal slope.

Occurrence.—On the hill south of Smethport, Pa. The matrix is a fine grained quartzitic sandstone which weathers to a light buff color. This locality, locally known as the 'Devil's Den', is a rock city made by huge blocks of Olean conglomerate. Underneath this is the fine-grained sandstone with an abundant aviculoid fauna. This latter horizon is probably Sub-Olean.

Leptodesma carinifera, n. sp. **Plate 24, fig. 3.**

Shell very large, elongate, very oblique. Cardinal line straight. Anterior end not produced forward; posterior extremity unknown, but growth lines suggest an obtuse condition. Ante-byssal margin sub-truncate; anterior margin almost straight or slightly

undulating (lower basal portion of anterior partially covered by matrix). Base well rounded and short.

Umbo terminating in anterior third of shell; well elevated, prominent, curving over cardinal line. The umbonal fold is much elevated in the form of a sub-angular carina which extends from the umbonal apex to near the base of the shell. Greatest elevation of the umbonal fold is before the hinge-line. Anterior umbonal slope regularly inclined, broad. Ante-byssal portion comparatively small and indistinctly defined. Post umbonal slope very abrupt anteriorly but becoming more gradual basally.

Surface marked by concentric growth lines which are impressed on the cast of the interior. They become slightly fasciculate anteriorly.

Hinge-line measures about 50 mm.; anterior length about 83 mm.; posterior length at least 42 mm.; distance along umbonal carina from apex to base 87 mm. Height about 22 mm. Width of anterior umbonal slope from crest to anterior margin 22 mm.

Associated with this large *Leptodesma* were many fragments of aviculoid shells, *Syringothyris angulata, Spirifer disjunctus, Camarotœchia allegania,* and *Ctenacanthus* spines, as well as an abundant poorly preserved flora.

Occurrence.—One mile southeast of Mt. Jewett on the road to Smethport, Pa. The horizon is characterized at this place by an abundance of flattened clay pellets and rounded quartz pebbles which are scattered throughout the greenish-brown sandstone. The faunule is probable of Oswayo age.

Leptodesma parallelum Simpson Plate 37, fig. 9.

Leptodesma parallelum Simp. Tr. Am. Phil. Soc. n. s. 16, 1888, p. 448.

Shell small, slightly oblique; body ovate; byssal margin often nearly parallel with the hinge-line; length usually a little more than twice the height; anterior margin rounded; basal margin nearly straight, a little constricted anterior to the middle; abruptly recurving to the posterior basal extremity; the posterior margin obliquely truncate.

Left valve convex on the umbo and flattened basally. Right valve slightly more convex than the left.

Hinge-line straight and equal to about three-fourths of that of the shell. Beak about one-fourth the length of the shell from the anterior end, prominent, directed forward; umbonal region convex; posterior slope steeper than anterior.

Anterior end short, angular at the extremity and rounded below. A depression extends from the beak to the basal margin a little anterior to the middle. Wing very narrow, joining the body near the posterior extremity; margin of wing straight, oblique; extremity obtusely angular. The wing is distinctly separated from the body.

The surface is marked with concentric striæ which frequently fasciculate on the front portion of the shell.

This species, if valid, is one of the most interesting of the many aviculoids occurring in the Devono-Carboniferous transition ground, for it has, according to the description, characters of *Leptodesma*, *Prorhynchus* and *Ptychopteria*. The exact stratigraphic position is unknown, but from its shape and affinities it seems to belong to the basal Conewango or upper Chemung.

Occurrence.—In the 'Chemung group' on a hill north of Warren, Pa.

Leiopteria cornelli, n. sp. **Plate 25, figs. 1, 3, 10.**

This species has the sub-rhomboidal, moderately oblique aviculoid shell which is characteristic of the genus. The hinge-line represents the greatest width of the shell. The length and width are to each other about as two is to three. Basally the shell is broadly rounded. The anterior margin arises from the base by a broad curve and continues almost straight to a little beyond the middle where it is slightly concave. It then becomes moderately convex as it extends around the ear. The front angle is oblique. The posterior margin is sigmoidal and cardinally attenuate. The gibbosity of the two shells is about equal. The umbo is decidedly anterior and is slightly elevated above the hinge-line. Its frontal margin curves abruptly to the small ear and the posterior margin more gradually curves to the large wing.

Concentric striæ are present on both valves; those on the right valve being unusually strong. They are best developed on the hinder part of the umbo just before it slopes to the wing. The varices follow the outline of the shell and in so doing are sigmoidal on the wing and convex on the ear. They become obsolete before they reach the cardinal line and also on the anterior part of the umbo. Indistinct radiating lines also present.

The concentric striæ of the left valve are weaker and have none of the regualrity of those on the right. They are more nearly like those of both valves of the majority of the species of this genus. The ear of the left valve is separated from the umbo by an abrupt declension, which may be accentuated by crumping.

Evidences of dentition and musculation are absent in the casts.

These specimens came from what is probably the *Venango First Oil Sand* of the Pennsylvania geologists at Stone Hill near Stoneham, Pa. This species is closely related to no described species so far as we are aware. The very heavy concentric striæ of the right valve are sufficient characters to establish its separate position. It has somewhat the appearance of *L. halli* Herrick from the Waverly of Ohio, but both valves of our specimens are not equally heavily striated and our specimens are larger than *L. halli.*

The figure which most closely approaches our specimens in appearance is that of *Pterina lævis* as pictured by A. Hellman in Die Petrefacten Thüringens nach dem Materiale des Herzogl. Naturalien-Kabinets in Gotha. 1866, Pl. 17, fig. 47. Our species is, of course, not a *Pterinea* lacking, as it does, the internal characters of that genus.

PEGASELLA, n. gen.

Pegasella ales, n. sp. **Plate 25a, figs. 3-10.**

Shell aviculoid; quadrilateral in outline; hinge-line straight; anterior portion slightly nasute; byssal sinus and front margin nearly perpendicular to the cardinal line; basal length nearly equal to cardinal length. Wing very large, frequently defined by a sulcus, but no fold present; apex of wing acute or attenuate, and often spiniferous in mature shell.

Ante-byssal portion small, nasute, defined by a well-marked byssal sinus; body broad at the base of the shell and acute at the apex; beak directed only slightly forward, located at the anterior part of the shell and elevated slightly above the hinge-line.

Surface marked by concentric varices which become fasciculate on the ante-byssal portion of the shell. Shell thin.

The height of the shell is individually variable, however the general features and relations are rather constant. More than a hundred specimens have been collected, all retaining both valves in place and preserved with the beak directed downward and the length perpendicular to the bedding planes of the sediment. They were evidently covered by sediment while boring in the sand. Due to the fragility of the shell few perfect specimens have been collected.

This genus (or sub-genus of *Avicula,* to use Frech's classifica-

tion of the Aviculidæ) is of greater height and less obliquity than *Leptodesma*. The ante-byssal portion is nasute as in *Leptodesma* and not rounded or auriculate as in *Leiopteria*. In general outline, and especially in the broad portion of the shell *Pegasella* much resembles *Leiopteria*. No diaphragm separating the anterior portion of the shell from the cavity of the beak such as exists in *Leiopteria* has been found in *Pegasella*. Many specimens, especially if partially eroded, have an outline appearance very similar to some of the Silurian *Clionychia*. (See: Ulrich, E. O. Pal. of Minn., Vol. 3, pt. 2, pl. 35.)

Occurrence.—In the Oswayo sandstone one mile north of Olean Rock City, N. Y., at what was formerly known as Flat Iron station. The beds are best exposed in a cut along the highway. Associated with *Pegasella* were many *Camarotœchia allegania, Oleanella expansa, Athyris angelica,* and *A. lamellosa*(?) *Spirifer disjunctus, Crania* cf. *leoni, Orbiculoidea,* etc.

PTERONITES

Pteronites profundus Hall **Plate 46, figs. 2, 4, 6.**

Pal. of N. Y., Vol. V, I, 1885, p. 237, pl. 22, figs. 25, 26, 27.

Size and appearance shown by illustration.

Occurrence.—The original description was based on material from the 'upper Chemung group' near Olean, N. Y., and in the vicinity of East Randolph and elsewhere in Cattaraugus county, N. Y.

Pteronites rostratus Hall **Plate 46, fig. 3.**

Pal. of N. Y., Vol. V, I, 1884, p. 238, pl. 22, fig. 24.

Size and appearance shown by illustration.

Occurrence.—The shales of the 'Chemung group' at Rockville, Allegany county, N. Y.

PRORHYNCHUS Hall

Geno-type: Palænatina quadrata Hall

"Shell inequivalve the left valve the larger and more gibbous; inequilateral, subquadrate or rhomboidal. Anterior end truncate, angular, or nasute at the antero-dorsal extremity. Posterior end broad, margin truncate or broadly rounded. Beaks low, appressed, the umbo of the right valve somewhat gibbous and rising above the hinge-line. Cardinal line straight, extending entire length of the dorsal margin and alate at both ends. Umbonal slope sub-angular, extending to the post basal extremity; post cardinal slope with an often obscure or more or less defined fold along the middle of its area."

Surface marked with more or less regular, fine concentric striæ of growth.

Hinge-line (in the cast) marked by a groove indicating a strong lateral tooth or fold. There is also a groove along the hinge-line anterior to the beak and a divergent furrow extending toward the anterior margin. Ligament external. Single, large muscular impression present on the posterior basal portion of the umbonal slope. Pallial line, if present, undetermined.

This group was formerly placed among the 'Dimyarians' by Hall and in the family Palænatinidæ, but the discovery of a specimen (*P. Paneplanus*) with a single large muscular scar located in much the same position as in *Leptodesma* would seem sufficient to change this genus to the 'Monomyarians' and make it a member of the family *Aviculidæ*. The genus *Prorhynchus* is probably closely related to the genus *Leptodesma*.*

Prohynchus quadratum Hall — Plate 40, fig. 16. Plate 37, figs. 10-14.

Prorhynchus quadratum Hall, Pal. of N. Y., Vol. V, pt. I, 1885, p. 492, pl. 79, figs. 40-49; 94, fig. 5.

Shell large, inequivalve, quadrate; length usually more than one-third greater than the hight; byssal margin straight or gently rounded, curving upward in front. Posterior extremity almost vertically truncate. Cardinal line straight. Anterior end produced above, sub-nasute, obliquely truncate or gently rounded below.

Left valve depressed—convex below and becoming gibbous in the middle and especially in the umbonal region. Right valve depressed—convex, almost flat.

Beaks at about anterior third, appressed, rising but little above the hinge. Umbonal slope of the left valve obtusely angular, somewhat arcuate, extending to the post-inferior angle. Post cardinal slope broad and marked by a fold below the middle of its length.

The surface is marked by fine concentric striæ, the impressions of which are left on the casts of the interior.

The cast shows some striæ or grooves on the posterior portion of the cardinal line; anterior to the beaks there is a groove along the hinge and a narrow, divergent furrow, extending from the beak half way to the anterior margin.

Length of left valves varying from 19 to 45 mm., height from 12 to 28 mm. The right valves vary from 22 to 32 mm. in length and 13 to 17 mm. in height[35].

The characters of this shell are its sub-quadrate rhomboidal form, long, straight hinge-line and angular or nasute anterior extremity.

Occurrence.—Originally described from a coarse sandstone in the 'Chemung group' south of Smethport, Pa. This is prabably

* The categories Monomyarian and Dimyarian have long since been shown to have little systematic value, but they still have a very useful descriptive application.

[35]Description taken from James Hall.

the sub-Olean sandstone. Specimens have also been collected at the same horizon at Glade, Pa.

Prorhynchus angulatum Hall Plate 37, fig. 6.

Prorhynchus angulatum Hall, Pal. of N. Y., Vol. V, pt. I, 1885, p. 493, pl. 96, fig. 7.

Shell large, sub-rhomboidal; length and height as five to three; basal margin nearly straight, oblique to the hinge-line. Posterior extremity obliquely truncate, slightly sinuate in the middle. Cardinal line elongate, straight. Anterior end long, narrow, produced above, angular at the extremity and retrally truncate below, to the antero-basal angle.

Right valve depressed convex, slightly concave from the beak to the base in a broad undefined depression. Left valve unknown.

Beaks behind the anterior third, low and inconspicuous. Umbonal slope defined, prominent, extending to the post inferior angle, which is abruptly rounded, limited on the upper side by a distinct furrow, which produces a slightly sinuosity in the margin. Post-cardinal slope broad.

Surface marked by fine concentric striæ.

A specimen has a length of 53 mm. and a height of 30 mm. at the posterior end and of 20 mm. at the beak[35].

Occurrence.—In the upper part of the Chemung group at Warren, Pa.

Prorhynchus harrisi, n. sp. Plate 23, fig. 7.

Described from the mold of a left valve.

Shell large, sub-quadrate, rather inflated. Basal margin diverges posteriorly from a parallel condition with the hinge-line. The anterior margin is oblique with the cardinal line and the posterior margin is nearly perpendicular to the cardinal line and extends above it in a broad arc for 13 mm. This forms a wing-like attachment above the hinge-line making this species unique. This wing may extend anteriorly slightly farther than the illustrated specimen shows.

The umbo is slightly elevated, is broadly nasute and extends only a little above the cardinal line. The shell is most gibbous about the middle of the umbonal slope. A broad sinus extends almost vertically from the umbo to the basal margin of the shell and causes at its termination a broad sinuosity in that margin. This sinus separates the umbonal fold into an anterior or lesser fold which terminates in the anterior rotundity of the shell and a posterior or greater fold which has its terminus at the posterior basal angle.

[35]Description from James Hall.

The surface is marked with fine concentric striæ of growth with an occasional one which is extra large. All of the striæ continue both on the ear and wing.

The cardinal line curves upward slightly at the front end and is gently rounded at the anterior angle of the 'ear'. The anterior portion is abruptly separated from the umbo by a steep anterior slope.

The mold shows the impression of a long lateral tooth along the hinge-line on each side of the beak. No trace of a ligamental area is preserved and no muscle scar or parallel sinus is present.

Dimensions:

Length along hinge-line	52 mm.
Perpendicular from umbo to base of shell	31 mm.
Anterior margin	23 mm.
Posterior margin to cardinal line	32 mm.
Height of posterior wing above cardinal line	11 mm.

Strange though this alate species is, it has a modern counterpart in the form of some of our *Unionidæ;* among these are *Unio delphinus* Lea, *Symphonoia inflata* Lea, *Symphonota lævissima* Lea, *Unio housei* Lea, and *Unio cummingsi* Lea. All of these have a large alate growth above the cardinal line and the explanation of the function of this wing in the living forms is just as difficult as it is in the case of this fossil.

This species is probably rather closely related to *P. quadratum* Hall.

Occurrence.—At Stickley, Penna. In a light brown quartzitic sandstone, lying some feet below the Olean conglomerate and above a coarse ferruginous sandstone containing on abundance of *Camarotœchia allegania* Wms. The light brown standstone is thought to be the correlate of the Pelecypod bearing sandstone which occurs below the Olean conglomerate at 'Devils Den' near Smethport, Penna.

Prorhynchus pæneplanus, n. sp. **Plate 23, fig. 5.**

Species described from the internal mold of a right valve.

Shell quadrate in outline; anterior and posterior nearly parallel to each other and nearly normal to the cardinal line. The shell is widest posteriorly. The base margin is concave; this marks the

end of a broad sinus. The cardinal line is straight. The umbo is situated anteriorly about two-thirds the length of the shell, and is slightly elevated above the cardinal line.

The shell is much flattened. A broad fold extends from the beak to the postero-basal angle. The crest of this fold is flattened near the beak but becomes concave as it nears the angle. A lesser fold extends from the beak across the beak to th median part of the hinder margin.

A shallow sinus extends along the base of the anterior umbonal slope to the basal margin where it widens considerably. A smaller sinus also exists between the fold on the wing and the main umbonal fold. This causes an invagination of the posterior margin where it terminates.

The surface was probably nearly smooth with poorly defined varices of growth over most of the shell and these becoming much heavier near the margin of the shell.

On the posterior-basal part of the umbonal fold there is a well-defined muscular impression.

Dimensions:

Hinge-line	42 mm.
Height (greatest)	42 mm.
Anterior marginal elevation	21 mm.
Perpendicular from beak to base	25 mm.
Greatest width	51 mm.
Hinge-line posterior to beak	27 mm.
Greatest diameter of muscular scar	17 mm.
Basal margin	46 mm.

This species differs from all the described species in the nearly equal in height and width, the well-defined muscle scar and the flat condition.

Occurrence.—The specimen described came from the fine-grained sandstone which lies just under the conglomerate (Olean) on the hill south of Smethport, Pa. The locality abounds in fragments of large *Leptodesma* and many fragments of *Prorhynchus.*

Prorhynchus nasutum Hall Plate 37, fig. 4.

Prorhynchus nasutum Hall, Pal. N. Y., Vol. V, pt. I, 1885, p. 493, pl. 96, fig. 6.

Shell of medium size, sub-rhomboid-ovate; length more than

one-third greater than the height; byssal margin nearly straight, curving upward in front. Posterior extremity almost vertically truncate. Cardinal line straight. Anterior nasute above, rounded below.

Left valve depressed-convex in the lower part, gibbous in the upper and umbonal regions. Right valve depressed-convex, scarcely gibbous above.

Beaks anterior to the middle, appressed, incurved, scarcely elevated above the hinge-line in the left valve. In the left valve there is a broad undefined depression extending vertically from the umbo to the base. Umbonal slope obtusely angular and broad in the left valve, less conspicuous in the right, extending to the post inferior angle. Post cardinal slope broad, limited by a shallow longitudinal depression just above the umbonal ridge.

Surface marked by fine concentric striæ which are sometimes fasciculous.

The illustrated specimen has a length of 25 mm. and a height of 18 mm.; the length including the nasute anterior is 29 mm.[36]

Occurrence.—In the upper Chemung beds at Warren, Pa. Several specimens of this species have been found in the Conewango beds at Glade, Pa., though all are broken.

OLEANELLA, new genus.

Type: **Ptychopteria expansa Hall**

Oleanella expansa (Hall) Plate 28, fig. 17.
Plate 30a, figs. 1-7.

Ptychopteria expansa Hall, Pal. of N. Y., V, I, 1885, p. 132, pl. 23, figs. 10, 11.

Aviculoid, hinge-line straight, wing large and undefined by a sulcus or fold; alar apex attenuate or acute; ante-byssal portion nasute and large, defined by a byssal sinus. Body narrow, attenuate at apex, mytiloid in general appearance and usually distinctly arched, thus creating an obviously convex posterior body margin.

The surface is radially plicate; the striæ on the anterior basal, and in some specimens on almost the whole anterior portion, abruptly geniculate, thus creating the appearance of two series of radii meeting acutely along the front umbonal angle. The striæ extend on both the anterior portion and the wing. Concentric striæ or varices intersect the radiating striæ and thus give the ex-

[36]The specimens from Glade of this species are much larger and more nearly of the dimensions of **P. harrisi**

terior of some specimens a fenestrated appearance. The varices become fasciculate anteriorly.

Upon examining the type specimen of J. Hall's *Ptychopteria expansa* we fail to find any extra wide intercostal space or over-developed rib which are mentioned as possible correlates of the ptychopteroid sinus and fold.

The genus differs from *Ptychopteria* in the rounded, narrow, attenuated body which is arched, the large undefined wing which terminates acutely, the large ante-byssal portion, coarser striæ, aviculoid outline of the mature shell and triangular shaped immature.

The specimen represented on Pl. 30A, figs. 5, 6, may be a varietal form of *O. expansa* for on this specimen the striæ are paired and such a development has not been observed on other specimens.

Occurrence.—J. Hall's specimen was found in a 'coarse sandstone of the upper Chemung group' near Smethport, Pa. The matrix in which the type is imprinted is identical with the Oswayo sandstone bearing many *Camerotœchia alleyania* which is found at Smethport, Pa. That this is quite probably the type horizon is further substantiated by the fact that all of the other specimens found came from the Oswayo sandstone in a road cut at Flat Iron station one mile north of Olean Rock City, N. Y.

Oleanella expansa, var. gamma, n. var. **Plate 30a, fig. 8.**

This variety, if as such it endures, is characterized by unusually well-developed striæ. It is found in the Flat Iron station faunule.

Actinopteria alpha n. sp **Plate 25, figs. 5, 6, 7.**

Shell semi-quadrate, medium sized; slightly nasute anteriorly with a small ante-byssal portion and a very large wing. Surface radially plicate; radii indistinct. Weak concentric striæ also present. Greatest resemblance to *A. subdecussata* Hall but this is not remarkably close.

This species may be closely related to *A. beta*, occurring as they do in the same faunule, but from the material as yet discovered this relationship is not obvious.

Occurrence.—In a local, very thin conglomeritic layer in the shales about 10 feet above the Roosevelt Highway on the north-

ern side of Smethport, Pa. The matrix is of a dark brown color with an abundance of light quartz pebbles and the fossils are all stained a rufous limonitic brown. Formation possibly Conewango.

Actinopteria beta, n. sp. **Plate 25, fig. 8.**

Transverse, winged; posterior cardinal extremity attenuate; anterior unknown but probably nasute and narrow. Surface with large radial costæ which are best developed on the umbonal fold and are much finer on the wing. Other characters shown by the illustration.

Occurrence.—See *A. alpha,* above.

Actinopteria sp. undet **Plate 25, fig. 4.**

From the Panama conglomerate at Checkered School House near Panama, N. Y., a medium sized specimen of *Actinopteria* of undetermined species was obtained. The specimen is in the form of an internal mold.

The shell is transversely subquadrate with a straight hinge-line which is the greatest width of the shell. The basal margin is only slightly rounded and nearly parallel to the cardinal line. The anterior margin curves gently on the basal-anterior angle and extends obliquely almost straight to the hinge line, and is only slightly convex where it bounds the small ear. The posterior margin is broadly rounded and meets the cardinal line obliquely.

The wing occupies about one-half the shell surface. The umbo is anterior and is elevated a little above the hinge line. The shell is most gibbous on the anterior half of the umbo. The ear is nearly obsolete.

On the posterior slope of the umbo slight radial plications are visible. Over the whole shell concentric plications of low relief are present.

Were is not for the slight radial plications this species would be almost an exact replica of *Leiopteria ortoni* Herrick. There is a slight similarity in general shape between this species and *A. perobliqua* (Con.) as pictured and described in Pal. N. Y. Vol. V, Pt. I. It also has much in common with *A. boydi* Hall and may be referred to this species when more and better material has been found.

PTYCHOPTERIA Hall

The genus *Ptychopteria* is characterized by a nasute anterior end, a large straight margined wing which has a well defined fold and is separated from the umbo by a depression. The surface is radially striate.

The genera[1] shape of the shell is not particularly characteristic, for several of the aviculoids, especially *Leptodesma* may have the same general appearance. It is the striate surface which really establishes the identity of this genus.

James Hall described twenty-two species of *Ptychopteria* in the *Paleontology* of *New York*. The type specimens of several of these species show only a few very slight differences and in as much as they were often described from the same horizon a real question arises as to the specific value of these differences.

This genus seems to be restricted to the Conewango beds of western New York and Pennsylvania. One very doubtful species of this genus was described from the Ithaca beds of Maryland in the Maryland Geological Survey.

Ptychopteria proto Hall — **Plate 28, figs. 1, 5, 6.**

Pal. of N. Y. vol. v, i, 1884, p .129, pl. 23, figs. 12, 14.

The anterior end is large and rounded, the wing small and triangular and the byssal sinus broad. The striæ are fine.

The larger anterior end, less sinuate basal margin and slightly coarser striæ seem to separate this species from *P. sinuosa,* to which it is closely related. *P. proto* was originally found in loose material at Portville, N. Y., and in a coarse sandstone of the 'upper Chemung' at Smethport, Pa.

Ptychopteria sinuosa Hall — **Plate 28, fig. 2.**

Pal. of N. Y. V, I, 1884, p. 130, pl. 23, fig. 13; pl. 85, fig. 8.

This species is characterized by a large narrow anterior portion, a narrow wing and broad byssal sinus. It is very closely related to *P. proto* though according to James Hall, the smaller anterior end, and coarser striæ, are sufficient to separate them.

This species is associated with *P. proto* in a coarse sandstone

of the 'upper Chemung' at Smethport, Pa., and at Warren, Pa., where it was associated with *Spirifer disjunctus*.

Ptychopteria salamanca Hall Plate 30, figs. 14, 15, 16.

Pal. of N. Y. Vol. I, 1884, p. 131, pl. 23, figs. 17-20.

The illustrations show the characters of the species. It may be that this species is only a smaller form of *P. beecheri* (and *spatulata*).

The type locality is a sandstone above the Salamanca conglomerate at Rock City, near Salamanca, N. Y.

Ptychopteria lobata Hall Plate 29, fig. 9.

Pal. of N. Y. Vol. I, 1884, p. 150, pl. 85, fig. 37.

This is a small species, the most characteristic thing about which is the unusually strong alar fold.

This species was found orignally in the 'upper Chemung group' at Warren, Pa.

Ptychopteria gibbosa Hall Plate 29, fig. 8.

Pal. of N. Y. Vol. V, I, 1884, p. 149, pl. 85, fig. 5.

The central'y located and prominent beak, the attenuate anterior portion of the shell, the large byssal sinus and strong fold and furrow of the wing characterize this rather small *Ptychopteria*.

It is found in the beds of the 'upper Chemung' at Warren, Pa.

Ptychopteria vanuxemi Hall Plate 29, fig. 17.

Pal. of N. Y., V, I, 1884, p. 151, pl. 85, fig. 36.

This is one of the most specialized forms of *Ptychopteria*. It approaches the genus *Pteronites* in its general appearance, as James Hall pointed out in his original description.

The type locality is the highest beds of the 'Chemung group' at Warren, Pa.

Ptychopteria trigonalis Hall Plate 28, fig. 9, 10.
Plate 27, fig. 10, 1.

Pal. of N. Y. Vol. V, I, 1884, p. 140, pl. 85, fig. 34, 35.

The most noticeably characters of this species are the large tri-

agonal shaped wing which is well delimited in the immature forms and less distinctly delimited in the mature, and the truncate rear margin.

There is some resemblance between this species and *P. falcata* and *P. alata* and when more well preserved specimens are found *P. trigonalis* will probably be referred to one of these species.

The type locality for this species is the sandy shale above the Panama conglomerate at Panama, N. Y. Several imperfect specimens have been found at Pope Hollow, N. Y., which were referred to this species.

Ptychopteria falcata Hall — **Plate 29, fig. 6, 7.**

Pal. of N. Y. Vol. V, I, 1884, p. 136, pl. 85, fig. 6, 7.

Ptychopteria galene Hall — **Plate 29, fig. 12, 13, 14.**

Pal. of N. Y. Vol. V. I, 1884, p. 142, pl. 85, fig. 29-31.

Ptychopteria perlata Hall — **Plate 29, fig. 4, 5.**

Pal. of N. Y. Vol. V, I, 1884, p. 147, pl. 85, fig. 38, 39.

Ptychopteria thalia Hall — **Plate 29, fig. 10, 11.**

Pal. of N. Y. Vol. V, I, 1884, p. 148, pl. 85, fig. 32, 33.

The characters of the species are shown sufficiently well by the illustrations. They are probably all very closely related, but the types have not been examined.

P. thalia and *falcata* come from the 'Chemung group' at Allegany Springs, Warren County, Pa.

P. galene and *perlata* come from the 'upper Chemung' at Warren, Pa. *P. perlata* is reported by Chas. Butts from above the Salamanca conglomerate[1].

P. lata comes from the middle of the 'Chemung series' which is exposed at Warren, Pa.

Ptychopteria alata Hall — **Plate 28, fig. 11-15. Plate 26, fig. 8. Plate 27, fig. 7, 8.**

Pal. of N. Y. Vol. V, I, 1884, pl. 85, fig. 26, pl. 23, figs. 21, 22, 25, 26.

The left valve is most gibbous, angular and elevated from the

[1]N. Y. State Mus. Bul. 69, p. 994.

umbo to the posterior extremity. The right valve is most alate. The other characters are shown by the illustrations which are natural size.

This species was described from a coarse sandstone of the 'Chemung group' near Salamanca, N. Y. Several of the specimens illustrated came from the Lamellibranch series[2] at Pope Hollow, Pa.

Ptychopteria beecheri Hall — Plate 29, fig. 1, 15, 16. Plate 27, fig. 1-4, 9. Plate 26, figs. 2, 4, 5, 7, 9.

Pal. of N. Y. Vol. V, I, 1884, p. 143, pl. 85, figs. 21, 22
Ptychopteria spatulata Hall
Pal. of N. Y. Vol. V, I, 1884, p. 144, pl. 85, fig. 20.

P. beecheri and *P. spatulata* are most certainly the same species as even a reference to the orignal illustrations will show. After studying many specimens which conform equally well to either 'species' it seems quite certain that the two are identical. Since *P beecheri* was the form first described the species should be known by this name.

Both forms were originally described from the 'upper Chemung' group at Warren, Pa. Many specimens of this species have also been found in the brown sandstone at Glade, Pa.

Ptychopteria eucrate Hall — Plate 28, fig. 3. Plate 30, figs. 7-13. Plate 26, fig. 3. Plate 27, fig. 5, 6.

Pal. of N. Y. Vol. V, I, 1884, p. 133, pl. 85, fig. 27, 28; pl. 23, fig. 24.
Ptychopteria elongata Hall
Pal. of N. Y. Vol. V, I, 1884, p. 141, pl. 85, figs. 10-14.
Ptychopteria eudora Hall
Pal. of N. Y. Vol. V, I, 1884, p. 138, pl. 85, fig. 9.

This species is usually narrower than *P. sao,* some forms of which seem to approach this species, and some forms are apparently intermediate between *P eucrate* and *P. alata.*

There seems to be no good reason for attempting to distinguish between the species *P. eucrate, elongata,* and *eudora* of Hall. The species *P. eudora* is represented by a single type specimen which seems to hold an intermediate position between the types of *P. elongata* and *P. eucrate.* These differences are probable

[2]See G. D. Harris, Am. Geol. Mar. 1891, p. 164.

only indivdual fluctuations.

This species (and synonyms) was orignally described from the Panama conglomerate at Panama, N. Y. Specimens have also been collected at the same horizon at Checkered School House near Panama. Several specimens which were referred to this species were also found at Glade, Pa., from what is probably a slightly higher stratigraphic position. C. Butts reports *P. elongata* from the Wolf Creek conglomerate[37].

Ptychopteria sao Hall — Plate 30, figs. 1-6. Plate 25, fig. 9. Plate 28, figs. 7, 8, 16, 18.

Pal. of N. Y., Vol. V, I, 1884, p. 133, pl. 23, fig. 16; pl. 85, fig. 14-18.
Ptychopteria thetis Hall
Pal. of N. Y. Vol. V, I, 1884, p. 135, pl. 85, fig. 1-4.
Ptychopteria spio Hall
Pal. of N. Y. Vol. V, I, 1884, p. 137, pl. 85, fig. 19.

The species of *Ptychopteria* which prevails in the Panama conglomerate is of the *P. sao* type. The species is extremely variable within rather definite limits, and several of these variations, which are only a few of the many, have been given specific names. There are a few forms of Ptychopteria which are associated with *P sao* which seem to be intermediate between *P sao* and *P. eucrate,* as described herein.

The species is present in abundance in the Panama conglomerate and was originally described from that horizon at Panama, N. Y.

(?) Ptychopteria obsoleta Simpson — Plate 37, fig. 3.
Ptychopteria obsoleta Simp. Tr. Am. Phil. Soc. ns. 16, 1888, p. 448, il.

Simpson's description (abbreviated).—

Shell of medium size, subrhomboidal in outline; body ovate-oblique, at an angle of about 40 degrees to the hinge-line; height about three-fourths the length. Anterior margin abruptly rounded; basal margin curved outward to the extremities, concave at the middle; posterior margin somewhat abruptly recurved.

Right valve unknown. Left valve moderately convex; greatest convexity at the umbonal region. Hinge-line straight; length sub-equal to the greatest width of shell. Anterior extremity acute, margin rounded.

[37]Bu. N. Y. State Mus. no. 69, p. 994.

Wing triangular, margin sigmoidal. Wing convex, flattened immediately below the cardinal line; separated from the body by a narrow but conspicuous depression.

Surface ornamented by faint radiating striæ, which are obsolete except on perfectly preserved specimens. Concentric striæ also present these becoming fasciculate anteriorly.

Note:

This species seems to be closely related to *Leptodesma parallelum* Simp. and possibly *Prorhynchus quadratum* which it very much resembles in outline. It has the ptychopteroid alar sinus and fold in addition to these other characters. It probably belongs to no genus at present defined though its relationship seems obvious even from the illustration. It is such a transition form as might be expected among these upper Devonian aviculoids.

Locality.—Chemung group, hill north of Warren, Pa.

MYTILARCA

Equivalve, inequilateral, mytiliform; beaks terminal; hinge short; ligamental area striated; cardinal teeth beneath the beak small, oblique; posterior teeth small, oblique, and at the extremity of the hinge; anterior muscle scar umbonal, and posterior one near the postero-basal margin; pallial-line entire, simple; surface not infrequently with fine obscure radiating striae.—From Miller.

Mytilarca chemungensis Hall Plate 39, fig. 1-6.

Pal. of N. Y., Vol. V, I, 1884, p. 258, pl. 32, figs. 8-11, 13, 14.

Occurrence.—Middle of the 'Chemung group' which is exposed at Rockville, Phillipsburg, Allegany county, N. Y., and at East Randolph, and in the 'Upper Chemung' beds at Warren, Pa.[38]

Mytilarca regularis Hall Plate 38, fig. 13.

Pal. of N. Y. Vol. V, I, 1884, p. 260, p. 32, fig. 12.

Occurrence.—In the sandstone of the 'Chemung group' near Leon Center, Cattaraugus county, N. Y.

[38]Prosser, Bul. Geol. Surv. of Ohio, No. 15, p. 460.

Mytilarca simplex Hall — Plate 38, figs. 6, 8.

Pal. of N. Y., Vol. V, I, 1884, p. 261, pl. 33, figs. 19, 21.

Occurrence.—In the sandstone of the 'Chemung group' west of Smethport, Pa,, and reported from the Oswayo by C. Butts.[39]

Mytilarca gibbosa Hall — Plate 39, figs. 4, 5. Plate 41, fig. 14.

Pal. of N. Y., Vol. V, I, 1884. p. 262, pl. 33, fig. 20; pl. 87, fig. 7.

Occurrence.—In the upper Chemung group at Napoli, Cattaraugus county, N. Y. Several specimens referred to this species have also been found at Stone Hill, southeast of Warren, Pa. in the upper Conewango beds.

Mytilarca lata Hall — Plate 38, fig. 10.

Pal. of N. Y. Vol. V, I, 1884, p. 262, pl. 3, fig. 22.

Occurrence.—In the 'Chemung group' at Randolph, Cattarugus county, N. Y.

Mytilarca occidentalis Hall — Plate 39, figs. 6, 7, 8.

Pal. of N. Y. Vol. V, I, 1884, p. 263, pl. 33, figs. 3-5; pl. 87, fig. 11.

Occurrence.—Originally described from the yellow sandstone of Burlington, Ia. Reported from the Panama conglomerate in Erie county, Pa., by J. P. Lesley.[40] One specimen from the Conewango formation two miles north of Warren, Pa., has been referred to this species.

MODIOLA

Resembles *Mytilus,* true *Modiola* and *Lithodomus* in general features. Hinge-line narrow, oblique, extending about half the length of the shell, beaks terminal—*emend* Miller.

Modiola (Mytilops) praecedens Hall — Plate 23, figs. 1, 3, 6. Plate 38, figs. 1-5, 11, 12. Plate 40, figs. 7, 8.

Pal. of N. Y., Vol. V, I, 1884, p. 267, pl. 33, figs. 9-18.

Occurrence.—In a conglomerate of the 'Chemung group' at

[39]Butts, Bul. N. Y. State Mus., No. 69, p. 995.
[40]Pa. Geol. Surv. Dict. of Fossils, p. 437.

Portville, N. Y., and southeast of Smethport, Pa. Specimens have also been taken at Bradford, Pa. in a conglomerate; some of these are shown on plate 40. *M. præcedens* is also reported by C. Butts from the Wolf Creek conglomerate[41].

Modiola (Mytilops) metella Hall — Plate 42, figs. 1, 8. Plate 38, figs. 7, 9.

Pal. of N. Y. Vol. V, I, 1884, p. 268, pl. 33, figs. 23, 24; pl. 87, fig. 9.

Occurrence.—In the Panama conglomerate at Panama, N. Y., and in a boulder of simlar rock on the road from Ellington to Cherry Creek, Chautauqua county, and at Warren, Pa. Specimens which have been referred to this species but which are nearly intermediate in general appearance of the internal molds between this species and *M. præcedens* were collected in a conglomerate at Bradford, Pa.

MODIOMORPHA

Equivalve, sub-ovate, larger posteriorly, compressed; beaks small; sinus oblique and constricting the base; surface concentrically undulated; single tooth in the left valve, and corresponding in the other; no lateral teeth; ligament external.—From Miller.

Modiomorpha rigida Hall — Plate 43, figs. 1-3.

Pal. of N. Y. Vol. V, I, 1885, p. 287, pl. 41, figs. 14-16.

Occurrence.—In the sandstone of the 'Chemung group' near Angelica and Rock Creek, Allegany county, N. Y.

Modiomorpha quadrula Hall — Plate 43, figs. 4-8.

Pal. of N. Y. Vol. V, I, 1885, p. 289, pl. 41, figs. 18-26.

Occurrence.—In the micaceous shales of the 'Chemung group' at Belmont and Rockville, in Allegany and Cattaraugus counties, N. Y.

PALEONEILO

Nuculiform, posterior end extended, sulcus along the umbonal slope; surface concentrically striated or ribbed; hinge-line arcu-

[41]Bul. N. Y. State Mus. No. 69. p. 993.

ate, crenulate, not interrupted beneath the beak by a ligamental pit; ligament external; anterior and posterior muscle scars distant; pedal scars within the umbonal cavity.—From Miller.

Paleoneilo elongata Hall **Plate 39, figs. 15, 16.**

Pal. of N. Y. Vol. V, I, 1885, p. 345, pl. 48, fig. 39; pl. 93, fig. 11a.

Occurrence.—In the shales of the 'Chemung group' at Phillipsburg, Allegany county, N. Y., and at Warren, Pa.

Paleoneilo sp. **Plate 40, fig. 12.**

A small specimen of *Paleoneilo* measuring 12.5 mm. in length and 9 mm. in height was found at Bradford, Pa. in the shales of the upper Chemung. It has a broad posterior sulcus which extends above the umbonal fold from the beak to the margin of the shell. The enlarged picture shows nearly all the characters of the shell. The specific relationship of this form can hardly be determined from this imperfect specimen.

NUCULA

Equivalve, inequilateral, oval, or oblong, closed all around, without external ligamentary facets; beaks directed backward; cartilage internal; placed in a pit under the beak; teeth numerous, very long.—From Miller.

Nucula globularis Hall **Plate 36, fig. 16.**

Pal. of N. Y. Vol. V, I, p. 322, pl. 93, fig. 6.

Occurrence.—In the Panama conglomerate at Panama, N. Y., where it is associated with *Ptychopteria sao* and *Spirifer disjunctus* and at Warren, Pa.

Nucula (?) sp. **Plate 41, fig. 6.**

From the middle Conewango beds at Glade, Somerset county, Pa., a specimen of undetermined affinities was found. In outline it is rather nuculoid, with a slight resemblance to *Yoldia*. However, all internal characters are unknown and while this is quite probably an undescribed form its description must await the discovery of more specimens.

GRAMMYSIA

Equivalve, inequilateral; shell thick, oblong; anterior side short, contracted by a deep oval lunette beneath the beak; posterior end elliptically rounded; hinge-line straight; two large ad-

ductor impressions in each valve, anterior rounded, posterior pear-shaped; pallial scar entire; cartilige external, short, in the anterior part of a deep depression formed by the inflexion of the hinge margins; an oblique furrow extends from beak to about the middle of the ventral margin.—From Miller.

Grammysia communis Hall **Plate 45, figs. 7-10.**

Pal. of N. Y. Vol. V, I, 1885, p. 378, pl. 61, figs. 24-28; pl. 93. fig. 20.

Occurrence.—In the 'Chemung group' at New Albion, Olean, Portville, and Little Genesee and at Warren, Pa. At the latter locality this species is in the upper Chemung, beds according to Prosser.[42]

Grammysia undata Hall **Plate 45, figs. 3, 4.**

Pal. of N. Y. Vol. V, I, 1885, p. 379, pl. 51, fig. 23; pl. 64, fig. 30; pl. 93, fig. 21.

Occurrence.—In the Panama conglomerate at Panama, N. Y., and in the same formation 4 miles north of Panama; at the same horizon at Allegany Springs, Warren county, Pa., and in sandy shales near Salamanca and Portville, N. Y.

Grammysia duplicata Hall **Plate 45, fig. 2.**

Pal. of N. Y. Vol. V, I, 1885, p. 380, pl. 93, fig. 23.

Occurrence.—In the upper beds of the 'Chemung group' at Warren, Pa.

Grammysia (?) subnasuta Hall **Plate 45, fig. 5.**

Pal. of N. Y. Vol. V, I, 1885, p. 507, pl. 64, figs. 5, 6.

Occurrence.—In a coarse sandstone or conglomerate of the 'Chemung group' at Portville, N. Y.

Grammysia (?) glabra Hall **Plate 45, fig. 6.**

Pal. of N. Y. Vol. V, I, 1885, p. 369, pl. 93, fig. 24.

Occurrence.—In the upper standstones of the 'Chemung group' at Warren, Pa., and doubtfully at Clark's farm, near Panama, N. Y.

[42]Bul. 15. Ohio Geol. Surv. p. 460.

SPHENOTUS

Equivalve, very inequilateral, elongate; anterior end short; posterior end obliquely truncate; cardinal line long, straight; umbonal ridge extending to the posterior extremity; surface concentrically lined; two short teeth beneath the beak of the right valve, and one or two slender lateral teeth; ligament external, contained in a groove; anterior muscular scar strongly marked; posterior scar shallow; pallial line simple.—From Miller.

Sphenotus contractus Hall — Plate 44, figs. 2, 3, 9-12, 14-17. Plate 42, fig. 4.

Pal. of N. Y. Vol. V, I, 1885, p. 399, pl. 66, figs. 1, 3-9, 11-13, 15; pl. 94, fig. 2.

This is probably the most common *Sphenotus* in western New York and Pennsylvania. There is a great deal of individual variation in the species, but they nearly always have a well marked longitudinal carina along the middle of the post-cardinal slope.

Occurrence.—In the 'Chemung group' at Phillipsburg and Rockville, Allegany county, N. Y.; near Olean and Randolph, Cattaraugus county, N. Y.; near Ellington and north of Panama, N. Y., and at Warren and Allegany Springs, Pa. Above the Salamanca conglomerate[43].

Sphenotus clavulus Hall — Plate 44, figs. 3, 7, 13. Plate 42, fig. 5.

Pal. of N. Y. Vol. V, I, 1885, p. 401, pl. 66, fig. 2, 20-26.

This form usually has no fold on the post-cardinal slope though it may have an obscure one. Other specific characters are shown by the pictures.

Occurrence.—In the 'Chemung group' at Phillipsburg and in loose masses of sandstone near Portville and Olean, N. Y. It is rather common in the Conewango beds. It is mentioned by Butts as occurring in the Wolf Creek conglomerate and by Prosser from the 'Riceville' formation of Meadville, Pa[44].

Sphenotus arcuatus Hall — Plate 44, fig. 19.

Pal. of N. Y. Vol. V, I, 1885, p. 400, pl. 66, fig. 18.

[43]Bul. N. Y. State Mus. No. 69, p. 994.
[44]Bul. Ohio. Geol. Surv. No. 15, p. 407.

Occurrence.—Originally described from the Panama conglomerate east of Panama, N. Y., and listed by Butts from the Wolf Creek and Salamanca conglomerates.

Sphenotus signatus Hall Plate 44, fig. 1.

Pal. of N. Y. Vol. V, I, 1885, p. 405, pl. 94, fig. 3.

Occurrence.—From the Waverly beds at Warren, Pa.

Sphenotus palmeræ n. sp. Plate 42, figs. 9, 10.

Shell of medium size, Sphenotoid in outline. Seems to most resemble *S. clavulus* in mass proportions.

The most outstanding character of this species is a much elevated ridge along the umbonal fold. This carina is much more strongly developed than in the usual *Sphenotus*. The carina is lower on the left valve than on the right, thus making the post-umbonal area of the left valve somewhat larger than that of the right. Both valves are of about equal size and gibbosity.

On the upper part of the post-umbonal area of each valve there is a second carina which is close to and parallel to the cardinal line.

The narrow dorsal (cardinal) surface of each valve, posterior to the beak, is flattened and lunule-like.

The surface is concentrically striate both on the anterior and posterior-umbonal regions.

The illustrations are one and a half times natural size.

This species is named for Dr. K. V. W. Palmer, research assistant in the Paleontology laboratory at Cornell University.

Occurrence.—In the Conewango formation one hundred feet above the road level at Glade, Pa. The matrix is a light brown quartzitic sandstone.

GONIOPHORA

Equivalve, very inequilateral, rhomboidal or trapezoidal, obliquely truncate behind, rounded in front; cardinal line straight; beaks small, umbo prominent, and slope continued as a ridge to the post-inferior margin; oblique undefined sinus from anterior of the beaks to the basal margin; surface concentrically lined; hinge with an oblique fold or tooth in the left valve beneath the beak, and a corresponding depression in the right valve; ligament external attached by one or more grooves; anterior muscular impression deep, situated anterior to the beak; Posterior

muscular impression shallow, situated on the posterior cardinal slope; pallial line simple.—From Miller.

Goniophora (?) curvata Simpson Plate 46, fig. 7.
Tr. Am. Phil. Soc. ns. 16, 1889, p. 451.

This is probably a form of *Sphenotus* rather than a true *Goniophora.*

Occurrence.—The 'Chemung group' north of Warren, Pa.

Goniophora ruedemanni n. sp. Plate 25a, figs. 12, 12a, 13.

Shell trapezoidal, large; cross-section nearly square; left valve with beak anterior, incurving, depressed; umbonal ridge very angular, extending from apex of beak to post-inferior margin in a broadly sinuate manner; post-umbonal portion larger than ante-umbonal portion with a low secondary sulcus extending from the beak to mid posterior margin and approximately bisecting the area; posterior margin nearly normal to the hinge-line; ante-umbonal portion with a broad sinus which is inferiorly expressed in a sweeping sinuosity; the portion of the shell in front of the beak almost entirely occupied by a large oval impressed adductor muscle scar; retractor muscle scar small, distinct, above the adductor and just under the beak; hinge-line straight; ligament external; one short anterior lateral tooth and a long well defined posterior lateral tooth present; surface with faint varices of growth.

The nearly vertical posterior margin, strong posterior lateral tooth, secondary post-umbonal sulcus and general contour differentiate this shell from any heretofore described species.

Occurrence.—In the Oswayo shales near the crest of Olean Rock City hill, at a place formerly known as Flat Iron Station. Usually found in life-like positions: normal to the bedding planes. Associated with an abundant and characteristic fauna; *Athyris angelica, Spirifer disjunctus, Camarotœchia allegania, Pegasella ales, Oleanella expansa, Leptodesma* sp. etc.

EDMONDIA

Shell equivalve, inequilateral, tumid, short, oblong or rounded, closed all around; dorsal and ventral margins slightly convex; beaks tumid with an appressed lunette between them; surface with concentric striae; no teeth, but an internal lamellar carti-

lage support, much dilated within the cavity of the beaks, the broad end forming the slits in casts coinciding with the edges of the anterior lunette, and the posterior end running nearly parallel to and close within the hinge-line; dorsal margins erect and simple; two simple adductor impression often with an accessory impression over each, pallial scar simple, entire.—From Miller.

Edmondia rhomboidea (Hall) Plate 36, fig. 9.

Pal. of N. Y. Vol. V, I, 1885, p. 386, pl. 64, figs. 7, 8.

Occurrence.—In a sandstone of the 'Chemung group' at Salamanca, N. Y., and four miles north of Panama, N. Y.

Edmondia phillipi Hall Plate 36, figs. 4-8.

Pal. of N. Y. Vol. V, I, 1885, p. 387, pl. 64, figs. 9, 11-14, 17, 29; pl 95; figs. 1-4.

Occurrence.—In the shales of the 'Chemung group' at Phillipsburg and Rockville and in the sandstone of Hobbieville and Conewango, N. Y. and in the shales of Mansfield, Pa.

Edmondia transversa Hall Plate 36, fig. 10.

Pal. of N. Y. Vol. V, I, 1885, p. 387, pl. 94, fig. 24.

Occurrence.—In the sandstone of the 'Chemung group' at Cold Spring, Cattaraugus county, N. Y. and doubtfully near Olean, N. Y.

Edmondia (?) subcarinata Hall Plate 36, fig. 11.

Pal. of N. Y. Vol. V, I, 1885, p. pl. 64, fig. 31.

Occurrence.—The 'Chemung group' near Olean, N. Y.

PARARCA Hall

The shells of this genus are equivalve, inequilateral, and transversely subelliptical or rhomboidal; the anterior end is short and rounded; the cardinal line is crenulate and arched at the beak. The surface is radially and concentrically plicate, the radial plications are usually fine[45].

The members of this genus are mostly upper Devonian or

[45]Generic description in part from Miller, North Am. Geol. and Pal.

Waverly in their distribution and are relatively common in fragmentary condition especially in the coarse sandstone and conglomerate lentils of northwestern Pennsylvania and south western New York.

Pararca venusta Hall **Plate 37, fig. 2.**

Hall, Pal. N. Y. Vol. V, pt. I, 1885, p. 431, pl. 94, fig. 24.

Shell large, broadly eliptical; length slightly greater than the height; basal margin gently and regularly curving. Posterior extremity broadly rounded. Cardinal line short and slightly arcuate. Anterior end short, regularly rounded below the lunule.

Valves regularly convex in the lower and posterior parts and gibbous in the middle and above.

Beaks sub-anterior and not prominent. Umbonal slope not defined, the line of greatest convexity arcuate and continuing from the beak to the post inferior extremity.

Surface marked by numerous fine rounded radi with narrower interspaces, the radii of the anterior end being stronger as they approach the margin of the shell; crossed by fine concentric lamellose striae, which toward the margin become fasciculate and produce stronger varices of growth.

Length 39, 43 mm.; height 31, 32 mm.

The species resembles *P. sao* in general form but is proportionally narrower posteriorly and marked by finer radii.

Occurrence.—In the upper part of the 'Chemung group', at Warren, Pa.; at Panama, N. Y. above the conglomerate.

Pararca neglecta Hall **Plate 37, fig. 5.**

Hall, Pal. N. Y. Vol. V, pt. I, 1885, p. 432, pl. 70, fig. 13.

Shell small, broadly sub-elliptical; length one-third greater than the height; basal margin regularly curved. Posterior extremity broadly rounded. Cardinal line straight, about half the length of the shell. Anterior end short, regularly rounded below the lunule.

Valves depressed convex below, becoming moderately convex in the umbonal region, somewhat flattened in the middle below the center.

Beaks at about the anterior third of the shell, low rounded,

rising but little above the hinge-line. Umbonal slope undefined.

Surface marked by numerous fine rounded radii which are much stronger at the anterior end. Interspaces much narrower than the radii. Entire surface also marked by strong, regular, undulating concentric lines.

This species is distinguished from *P. transversa* by its broader and less gibbous form, coarser radii, coarser and regular concentric striae, and undefined umbonal slope.

Occurrence.—In the sandstones of the Waverly group at Meadville, Pa.

Pararca sao Hall **Plate 37, fig. 1.**

Hall, Pa. of N. Y. Vol. V, pt. I; 1885, p. 430, pl. 70, fig. 17.

Shell large broadly elliptical; length less than one-third greater than the height; basal margin regularly curving. Posterior extremity obliquely sub-truncate. Cardinal line slightly arcuate. Anterior end short and regularly rounded below the lunule.

Valves regularly convex below, becoming gibbous in the middle and in the umbonal region.

Peaks sub-anterior, moderately prominent and incurved. Umbonal slope convex, not strongly defined, extending in an arch direct to the post basal extremity.

Surface marked by numerous strong, rounded plications. Those on the anterior basal margin are much stronger than those on the posterior half of the shell. Interspaces narrower than the radii. All the plications except those of the anterior end are arcuate, corresponding essentially with the direction of the umbonal slope. Entire surface marked by fine concentric striae of growth.

Two specimens measured respectively 45 and 50 mm. in length and 32 and 37 mm. in height.

This species somewhat resembles in form *P. transversa* but it has a much larger shell, the radii coarser and the umbonal slope not nearly so abrupt.

Occurrence.—In the 'Chemung group' at Meadville, Pa. associated with *Spirifer disjunctus;* also found near Uniontown, Pa.

Pararca erecta Hall Plate 42, fig. 6.

Hall, Pal. N. Y. Vol. 5, pt. I, 1885, p. 432, pl. 70, fig. 16; pl. 94; figs. 20, 21.

Shell quadrilateral; height and length nearly equal; hinge-line arched. Cardinal line at least one-half the width of the shell. Basal margin regularly rounded, curves abruptly to anterior and posterior margins. The anterior margin is shorter than the posterior, regularly rounded to the cardinal line; posterior margin slightly convex, almost vertical.

Gibbosity slight, greatest on the umbo. Shell depressed along the median line, from the umbo to the basal margin. Beak at about the anterior third, much elevated, prominent and abruptly incurved. Anterior umbonal slope very abrupt; posterior slope more gradual.

Surface sculpture consists of numerous fine, rounded, closely spaced radii. The posterior radii are coarser than the mesial ones and those on the anterior portion of the shell are much larger and farther apart than those of either of the other two series. Inconspicuous concentrically undulating striae are also present. These become fasciculate and cause lines of growth on the lower and anterior portions of the shell.

Ligamental area narrow and the hinge line crenulate.

Length varies from 22 to 28 mm. and the height from 20 to 36 mm.

Our specimens are smaller than those described by Hall and constitute the minimum in the above description. The beaks of our specimens are much more elevated than those of any of the specimens pictured by Hall.

This species is characterized by its erect rhomboidal form, and nearly equal length and height. The radii are finer than in *P. venusta.*

Occurrence.—The species was originally described from the Waverly group at Warren, Pa. and Meadville, Pa. Our material came from the Panama conglomerate at the ledge near the 'Checkered School House'.

SPIRODOMUS

Spirodomus insignis Beecher Plate 59, figs. 1, 2.

39th Rep. N. Y. S. Mus. of Nat. Hist. 1886, p. 162, pl. 12, figs. 1-5.

Beecher's original description: "Shell cylindrical, longitudinally spiral or twisted, the margins making nearly a complete volution; length nearly three times the breadth. Ventral margin entire, curved. Dorsal margin of the same curvature as the ventral border. Hinge-line extremely short or obsolete.

"Valves compressed posteriorly, gibbous along the middle and anterior portions. The transverse section of the two halves in position, in the middle of their length, is broadly elliptical. The greatest depth of both valves is in the anterior third.

"Beaks terminal, small and appressed, situated in the middle of the anterior end. Umbo not prominent.

"Test thin. Surface marked by very fine striae of growth. Ventral and dorsal margins strongly crenulate, produced in a thin reflexed expansion. Posterior margin simple, slightly bent.

"The cast of the interior is marked by a small, distinct pit or depression at the anterior extremity, and just below is, apparently, a small muscular scar. The upper part of the posterior muscular impression, in the cast, is marked by two or three nodes, from which a low rounded ridge extends anteriorly about one-third the length of the shell and then becomes merged in the general convexity of the valve. This ridge was probably produced in the recession of the muscular scar consequent on the growth of the shell.

"A specimen of medium size has a length of about 82 mm.; greatest breadth of cast 30 mm.; breadth of posterior end 21 mm.; greatest depth of both valves as conjoined 19 mm.; and the width at this point is 24 mm.

This was presumably a burrowing bi-valve in which the torsion, so frequently associated with the burrowing habit, has been carried to an extreme. The writer is unaware of any record for this form since the orignal discovery.

Occurrence.—In the Waverly beds in north western Pennsylvania, near Warren, Pa.

Pararca transversa Hall **Plate 42, fig. 7.**

Pararca transversa Hall, Pal. of N. Y. Vol. V, pt. I, 1885, p. 429, pl. 70 figs. 12, 13, 14.

Small, oblong, sub-elliptical; basal margin gently curving; posterior margin broadly rounded; cardinal line straight; anterior end short and regularly rounded.

Valves equally convex below, gibbous in the middle and upper portion. Beak at about the anterior third of the shell, prominent, directed forward incurved; postumbonal slope gibbous, defined and extending to the rear margin.

Surface marked by numerous fine radii which are sometimes stronger on the anterior end. Fine concentric striae are also

present.

Anterior muscle often well defined, situated just below the lunule.

Length usually from 22 to 25 mm. and height 15 to 16 mm. The specimen pictured measures 13 mm. in length and 9 mm. in height, and is probably an immature form.

This species is smaller than *P. sao* and has finer and more numerous ribs which are usually not arched.

Occurrence.—Originally described from the 'Chemung group' at Salamana, N. Y. and Warren, Pa. Our material came from the Oswayo beds at Flat Iron station near Olean Rock City, N. Y.

Pararca equilateralis n. sp. **Plate 42, fig. 3.**

Shell transversely ovate; height 28-30 mm. length 33 mm.; left valve equilateral; basal margin broadly rounded. Shell mesially most gibbous. Surface ornamentation consists of rounded radial plications which are not represented in high relief on the specimen examined. The interspaces between the individual ribs are a little wider than the width of an indivdual tria. Concentric striae intersect the radial plicae and toward the front of the shell become lamellate, thus giving the anterior surface a berufiled appearance.

This species differs from all described Pararcas in the equilateral condition of the shell, the unusually coarse plications, and the lamellate varices of growth.

Occurrence.—In a coarse buff colored sandstone at Glade, Pa. This is a very fossiliferous layer and may be the correlate of the Venango First Oil Sand on Stone Hill, near Stoneham, Pa.

Pararca, sp. undet. **Plate 30A, fig. 12.**

In the Oswayo formation one mile north of Olean Rock City, N. Y. in a road cut along the macadam highway several fragments of a large *Pararca* shell were found, All the known characteristics of this specimen are shown by the natural sized illustration.

PARACYCLAS

Equivalve, subequilateral, suborbicular or subelliptical; anterior end regularly rounded or subtruncate, more produced than

the anterior; beaks small and low; hinge-line short, post-cardinal slope sometimes subalate; surface marked concentrically; ligament supported internally on each side by a narrow plate, which leaves in the cast two diverging grooves directed forward from the beak; muscular impression on the post-umbonal slope; pallial line a little within the margin of the shell.

Paracyclas erecta Hall — **Plate 45, fig. 1.**
Pal. of N. Y. Vol. V, I, 1885, p. 445, pl. 95, fig. 22.

Occurrence.—From the upper members of the 'Chemung group' at Warren, Pa. The specimens pictured were found in the yellow sandstone of the Conewango formation at Glade, Pa.

Paracyclas ignota Hall. — **Plate 36, fig. 12.**
Pal. of N. Y. Vol. VI, 1885, p. 444, pl. 72, fig. 34.

Occurrence.—The 'Chemung group' at Meadville, Pa.

Paracyclas (?) pauper Hall — **Plate 36, figs. 13-15.**
Pal. of N. Y. Vol. V, I, 1885, p. 446, pl. 75, figs. 24-26; pl. 95, fig. 20.

Occurrence.—In the sandstone of the 'Chemung group' at Portville, N. Y.

SCHIZODUS

Shell oval or subtrigonal; anterior side rounded, shorter than the other; posterior side tapering, truncate at the extremity, umbonal ridge extending to the postero-basal region; beaks prominent; surface smooth or with concentric striae; hinge with two smooth cardinal teeth in the right valve and three in the left; middle tooth of the left valve bifid, and fitting between two of the right valve; free margins smooth.

Schizodus rhombeus Hall — **Plate 43, figs. 17, 18, 22.**
Pal. of N. Y. Vol. V, I, 1885, p. 452, pl. 75, figs. 19-23.

Occurrence.—In the sandstone of the Panama conglomerate in Chautauqua County, N. Y. and the middle of the 'Chemung' beds as seen near Hobbiesville, N. Y. Prosser reports this species from the top of the Bedford shales at Pennline, Pa.[47] Butts reports *S. rhombeus* from the Wolf Creek and Salamanca conglomerates[49].

Schizodus chemungensis var. quadrangularis Hall — **Plate 43, figs. 9-11, 16.**
Pal. of N. Y. Vol. V, I, 1885, p. 454, pl. 75, figs. 31-34, 36.

Although this variety was first described from the Portage

[47] Prosser, Geol. Surv. of Ohio, Bul. 15, p. 39.

beds at Ithaca, N. Y. and the 'Chemung' at Factoryville, Tioga County, Pa. it has been found by Prosser at Meadville, Pa. in what he calls the Riceville formation[48]. It is reported from the Salamanca conglomerate by Butts[49] and from the 'Chemung-Salamanca conglomerate by C. Butts[49] and from the 'Chemung-Catskill' at Warren, Pa. by Lesley[50].

Schizodus cuneus Hall **Plate 43, figs. 13, 14.**

Pal. of N. Y. Vol. V, I, 1885, p. 458, pl. 75, figs. 29, 30.

Occurrence.—Waverly sandstone at Granville, Ohio.

Schizodus oblatus Hall **Plate 43, figs. 10, 12.**

Pal. of N. Y. Vol. V, I, 1885, p. 455, pl. 75, figs. 43, 44.

Occurrence.—In a sandstone of the 'Chemung group' at Cold Spring, Napoli, Cattaraugus County, N. Y.

PROTHYRIS

Equivalve, inequilateral, extremely elongate; cardinal and basal margins subparallel; anterior end rounded or subtruncate, with a deep notch in the antero-ventral margin; posterior end rounded, lanceolate, or truncate; cardinal line straight or slightly arcuate; cardinal slope sometime subalate; umbonal slope rounded, undefined or subangular; surface concentrically lined.

(?) Prothyris exuta Hall **Plate 39, fig. 12.**

Pal. of N. Y. Vol. V, I, 1885, p. 462, pl. 94, fig. 9.

The most noticable features of this shell are the anterior fold and construction. Only one specimen seems to be on record from the region and this has the beak missing as is shown. It is interesting to note that James Hall suggests that the creature had this part missing in the livng state.

Occurrence.—From the 'upper Chemung group' at Warren, Pa.

[48]Ibid. p. 406.
[49]Butts, N. Y. State Mus. Bul. 69, p. 994.
[50]Lesley, Pa. Geol. Surv. Dict. of Fossils, p. 937.

PHTHONIA Hall

Equivalve, elongate-ovate, wider posteriorly; beaks obscure; surface radiated and concentrically marked; no teeth; ligament external

Phthonia truncata Hall Plate 39, fig. 4.

Pal. of N. Y. Vol. V, I, 1885, p. 476, pl. 94, fig. 4.

Occurrence.—In the 'Chemung group' southeast of Panama, N. Y.

Phthonia nitida Hall Plate 39, figs. 10, 11.

Pal. of N. Y. Vol. V, I, 1885, p. 477, pl. 94, figs. 5, 6.

Occurrence.—In a shale of the 'Chemung group' near the level of the Allegany river at Warren, Pa. Associated with *Echinocaris socialis* and other *Phyllocarida*.

CYPRICARDINIA

Quadrilateral, inequilateral; with an oblique posterior ridge; umbones anterior elevated; concentrically grooved, sometimes cancellated; postero-cardinal margins sometimes alate. Resembles in general contour the *Cypricardia*.

Cypricardinia consimilis Hall Plate 39, figs. 13, 14.

Pal. of N. Y. Vol. V, I, 1885, p. 486, pl. 79, figs. 19, 20, 21; pl. 96, fig. 3.

Occurrence.—From the Waverly sandstone, Licking and Medina counties, Ohio, and at Warren, Pa.

PALEANATINA

Transversely elongate; gaping; left valve the larger; oblique construction; hook-like process anterior to the beaks; no lateral teeth; surface concentrically lined.

Paleanatina typa Hall Plate 40, figs. 2, 3, 6, 13-15. Plate 41, fig. 11. Plate 45, figs. 12, 13, 15, 19, 20.

Pal. of N. Y. Vol. V, I, 1885, p. 488, pl. 79, figs. 26-28, 35-37.

Occurrence.—Described from a conglomerate in the 'Chemung group' at Portville, Cattaraugus County, N. Y. It has also been reported by Butts from the Wolf Creek conglomerate[51]. The

[51] N. Y. State Mus. Bul. 69, p. 994

species is common at Bradford, Pa. at probably the same stratigraphic position.

Paleanatina solenoides Hall **Plate 39, figs. 17, 18.**

Pal. of N. Y. Vol. V, I, 1885, p. 487, pl. 79, figs. 38, 39.

Occurrence.—Described from a conglomerate of the 'Chemung group' near Portville, Allegany County, N. Y. This species is also reported by C. Butts from the Wolf Creek and Salamanca conglomerates[51].

Plate 41, fig. 10.
Paleanatina angusta Hall **Plate 45, fig. 11, 14, 16, 18.**

Pal. of N. Y. Vol. V, I, 1885, p. 490, pl. 79, figs. 29-34.

This is a smaller and more elongate species than the preceeding two. (Figure 14, plate may not belong to this species as James Hall points out in the original description.)

Occurrence.—In a conglomerate of the 'Chemung group' near Portville, N. Y.

Paleanatina sinuata Hall **Plate 39, fig. 19.**

Pal. of N. Y. Vol. V, I, 1885, p. 491, pl. 96, fig. 4.

The well developed 'wing' which is separated from the umbonal ridge by a rather deep sulcus is characteristic of this species.

Occurrence.—The 'Chemung group' at Warren, Pa.

ELYMELLA

Equivalve, inequilateral, ovate, elliptical; anterior end short, rounded; posterior end narrow, rounded; beaks closely incurved; umbo prominent in the upper part, not defined below; surface concentrically lined.

Elymella (?) chadwicki n. sp. **Plate 42, fig. 2.**

Shell large, nuculoid, moderately convex. Umbo moderately elevated. Length 41 mm.; height 29 mm. Beak in the anterior fourth of the shell; surface marked by concentric striae of varying size; these become fasciculate on the anterior portion of the shell. Other specific characters are shown by the illustration.

Due to the absence of musculation impressions and dentition the exact generic reference of this species is impossible at pres

[51]N. Y. State Mus. Bul. 69, p. 994

ent. In general appearance this shell most resembles the illustrations of *Elymella patulata* Hall.

This species is named for Prof. G. H. Chadwick whose work on the stratigraphy of western New York and surrounding regions is a real contribution to Geology.

Occurrence.—In the very fossiliferous beds, which have been referred to the Venango First Oil Sand by Verwiebe on Stone Hill southeast of Stoneham, Pa. The most common of the associated species are *Spirifer disjunctus* and *Syrin . angulata.*

SANGUINOLITES

Subequivalve, oblong, elongated, margins sub-parallel or little arched upward; sides compressed or diagonally gibbous from the beak backward; beaks small, anterior; hinge nearly as long as the shell, margin inflected to form a long posterior lunette; surface wrinkled; large, oval adductor impression in front of the beak surmounted by a small retractor; posterior adductor large; cartilage external; pallial line entire; shell thin.

Sanguinolites (?) undulatus Hall — Plate 43, figs. 15, 19.

Pal. of N. Y. Vol. V, I, 1885, p. 508, pl. 64, figs. 1, 2.

Occurrence.—Sandy shales of the 'Chemung group' near Great Valley and East Randolph, Cattaraugus County, N. Y.

Sanguinolites (?) subtruncatus Hall — Plate 43, figs. 20, 21.

Pal. of N. Y. Vol. V, I, 1885, p. 508, pl. 64, figs. 3, 4.

Occurrence.—In the arenaceous shales of the 'Chemung group' at Conewango, Cattaraugus County, and at Cherry Creek, Chautauqua County, N. Y.

GASTROPODA

BELLEROPHON

Bellerophon mæra Hall — Plate 47, figs. 3-8.

Pal. of N. Y. 1879, p. 119, pl. 25, figs. 4-9, 26; pl. 26, figs. 19-24.

Occurrence.—In the shaly beds of the 'Chemung group' at Phillipsburg, Allegany County, and in the sandstone below the conglomerate near Mansfield, Tioga County, Pa. etc. Specimens referred to this species were found in the sandstone immediate

ly above the Sub Olean conglomerate just east of Stoneham, Pa.

EUOMPHALUS

Euomphalus (Straparollus) hecale Hall — **Plate 47, figs. 9-13. Plate 48, figs. 1, 2, 13.**

Pal. of N. Y. Vol. V, II, 1879, p. 59, pl. 16, figs. 10-14.

Occurrence.—In the 'Chemung group' at Rockville, Allegany County, N. Y., near Ithaca (in the Portage) at Elmira and at Meadville, Pa. This species is very common in the Panama conglomerate at Checkered School House near Panama, N. Y. also in the Salamanca conglomerate north of Salamanca, N. Y.

Euomphalus sp. — **Plate 1.**

Internal molds and external impressions of an euomphaloid form is very common in the sandstone of the Venango First Oil Sand group on Stone Hill south east of Warren, Pa.

PLATYCERAS

Members of this genus are extremely common in the fossiliferous sandstone just above the Sub-Olean conglomerate on Stone Hill, and at Stoneham, Pa. These beds are referred by Verwiebe to the Venango First Oil Sand group. This is quite possibly the horizon to which Simpson had reference when he says 'Chemung group' in the descriptions of his various species from near Warren, Pa.

Platyceras dorsale Simp. — **Plate 46, figs. 8, 9.**

Tr. Am. Phil. Soc. ns. 16, 1889, p. 454, fig. 24, nos. 1, 2.

Occurrence.—In the 'Chemung group' three miles north west of Warren, Pa. Specimens which have been referred to this species were also found in the sandstones of Lower Carboniferous age at Glade, Pa.

Platyceras breve Simp. — **Plate 46, figs. 10-13.**

Tr. Am. Phil. Soc. ns. -6, 1889, p. 454, fig. 23, no. 4.

Occurrence.—In the 'Chemung group' near Warren, Pa.

Platyceras striatum Simp. — **Plate 46, figs. 14, 15.**

Tr. Am. Phil. Soc. ns. 16, 1889, p. 457, fig. 27, nos, 1, 2.

Occurrence.—In the 'Chemung group' four miles north west of Warren, Pa.

Platyceras inæquale Simp. **Plate 46, figs. 16-18.**

Tr. Am. Phil. Soc. ns. 16, 1889, p. 456, fig. 25, nos. 1, 2, 3.

Occurrence.—In the 'Chemung group' four miles north west of Warren, Pa.

Platyceras mitelliforme Simp. **Plate 46, figs. 19, 20.**

Tr. Am. Phil. Soc. ns. 16, 1889, p. 456, fig. 26.

It would seem that this species and *P. inæquale* are synonymous.

Occurrence.—From the 'Chemung group' near Warren, Pa. Specimens very near to both this species and *P. inæqual* have been found in the Venango First Oil sand as exposed on Stone Hill near Stoneham, Pa.

Platyceras varians Simp. **Plate 46, fig. 21.**

Tr. Am. Phil. Soc. ns. 16, 1889, p. 458, figs. 28.

Occurrence.—In the 'Chemung group' four miles north west of Warren, Pa.

Platyceras reudemanni, n. sp. **Plate 48, figs. 4, 5.**

This species is known only from a single imperfect mold but is so different from all the associated Platyceras that it seems to warrant description.

The fragment is 31 mm. high and 16 mm. in width at the base (ventral-dorsal diameter).

The illustration is natural size and shows nearly all of the characteristic features of the shell.

The large size, slightly coiled condition, carinated dorsum, and sinuous peristome together with the surface varices of growth, best seen near the peristome, characterize the species.

This form seems to be closest related to the uncoiled forms described by Simpson from western Penna. such as *P. dorsale,* which is not coiled as much and is more conical and shorter though it does have the definite dorsal carina and surface striations near the peristome.

Occurrence.—In a very fossiliferous sandy limestone which weathers to a dark chocolate brown stone containing an abundance of molds and casts, one and a half miles east of Glade, Pa. This is probably the Oswayo horizon.

PLEUROTOMARIA

Pleurotomaria sp. **Plate 48, figs. 3, 10, 11, 12, 14, 15.**

A small, profusely ornamented *Pleurotomaria* is one of the rather common fossils found in the brownish yellow sandstone belonging to the Venango First Oil Sand group (Cuyahoga) at Stone Hill, south east of Stoneham, Pa. The specimens usually are from 4 to 5 mm. in height and five or six whorls are usually visible. It is quite probably a form closely related to species described from Illinois, or Ohio Mississippi beds. The specific determination is uncertain at this time.

Associated with this genus are *Syringothyris angulata, Spirifer disjunctus, Chonetes, Euomphalus, Camerotœchia contaracta* and *sappho, Retzial* sp., *Elymella* (?), *Platyceras, Bellerophon, Reticularia praematura,* etc.

Anomia (?), Archinacella (?) incerta n. sp. **Plate 41, fig. 13.**

(Description based on a single known specimen.)

Shell ovate in outline; length 25 mms. width 21 mms.; regularly convex, slightly more gibbous anteriorly. Umbone orignates at the front margin; sides slightly flaring.

Surface marked by concentric growth lines which are imbricate on the anterior lateral margins. A poorly developed umbonal carina is present, though this may be caused by pressure. (The similarity of this carina to that present in many East Coast *Anomia* is remarkable). The microscopic ornamentation consists of two series of radiating striae. The coarser of these is barely discernible microscopically; the other and much finer series is visible only upon considerable magnification, and occupies the spaces between the first series. The striae are best developed umbonally.

The shell structure is punctate and granular and has a chitonous appearance much resembling the shells of *Lingula* or *Orbiculoidea* and on this evidence seems more likely referable to the Brachiopoda.

Note.—The internal characters of this shell are unknown, except for two or three indistinct shallow, ovoid depressions on the umbonal area which might represent the collapse of the shell

over internal muscular scars. The external appearance of this shell is remarkably like that of *Anomia simplex Anomia ephippium*) of the East Coast, however, the shell structure seems to preclude a reference to the Pelecypoda. It also is very much like the Gastropod *Archinacella* of Ulrich[52] in general external appearance, but *Archinacella* has no striæ and seems to have never been found so high in the geologic scale. Briefly, this is among the *incertæ sedes.*

Occurrence.—At the base of the Conewango at Stone Hill near Stoneham, Pa. The matrix is a fine gray shale and bears an abundant fauna.

CEPHALOPODA

ORTHOCERAS

Orthoceras leander Hall Plate 49, fig. 8

Pal. of N. Y. Vol. V, II, 1879, p. 309, pl. 90, figs. 6-8.

Occurrence.—From the sandstone of the 'Upper Chemung' at Warren, Pa.

Orthoceras bipartitum Hall Plate 50, figs. 9, 10.

Pal. of N. Y. Vol. V, II, 1879, p. 313, pl. 113, figs. 20, 21.

Occurrence.—In the sandstones of the 'Upper Chemung' group at Warren, Pa.

Orthoceras warrenense Miller Plate 50, fig. 7.

Orthoceras cochleatum Hall, Pal. of N. Y. V, II, 1879, p. 308, pl. 113, fig. 19.

Orthoceras warrenense Miller, N. A. Geol. and Pal. 1889, p. 452.

Occurrence.—In the sandstones of the 'Chemung group' at Warren, Pa.

Orthoceras consortale Beecher Plate 50, figs. 3-5.

Pal. of N. Y. Vol. VII, 1888, p. 29, pl. 118, figs. 3-5.

Occurrence.—In the sandstones of the 'Chemung group' at Panama, N. Y.

Orthoceras sp. Plate 49, figs. 1, 2, 7.

In the highest conglomerate on Robins Hill about one mile east of the Cattaraugus-Chautauqua County line a very large Orthoceras was found. The specific affinities are not yet determined.

In the sandstone from the Venango First Oil Sand horizon

[52]Ulrich, E. O. Geol. Surv. Minn, III, pt. II, 1897.

at Stoneham and Stone Hill and Cobham, Pa. fragments of Orthoceras are not uncommon. In this place they are usually small.

CYRTOCERAS

Cyrtoceras (?) hector Hall — **Plate 50, figs. 4, 5.**

Pal. of N. Y. Vol, V. II, 1879, p. 364, pl. 90, figs. 11-16.

Occurrence.—In a sandstone of the 'Upper Chemung' at Olean. N. Y. and also at Warren, Pa.

GOMPHOCERAS

Gomphoceras nasutum Hall — **Plate 49, fig. 6.**

Pal. of N. Y. Vol. VII, 1888, p. 34, pl. 120, figs. 5-7.

Occurrence.—In the arenaceous shales of the 'Chemung group' at Belmont and Belvidere, Allegany County, N. Y.

Gomphoceras tumidum Hall — **Plate 50, fig. 2.**

Pal. of N. Y. Vol. V, II, 1879, p. 351, pl. 93, fig. 6; pl. 95, figs. 2-5, 7.

Occurrence.—In the shales of the 'Chemung group' near Ithaca, N. Y. and in the calcareous beds of the 'Upper Chemung' group near New Albion, Cattaraugus County, N. Y.

Gomphoceras sp. — **Plate 49, fig. 3.**

In the light brown quartzitic sandstone 100 feet above the road at Glade, Pa. the specimen illustrated was found. The illustration is natural size. The specific reference of this specimen is not known. With it were many large *Ptychopteria* and *Leptodesma*, and many *Spirifer disjunctus*.

GYROCERAS

Gyroceras stebos Hall — **Plate 47, fig. 1.**

Pal. of N. Y. Vol. VII, 1888, p. 36, pl. 125, fig. 7.

This is one of the finest fossils from the Warren area, but is evidently very rare. It seems to have never been recorded since the original description was written.

Occurrence.— In the sandstone of the Waverly group at Warren, Pa.

DICTYOSPONGES

These are usually large, funnel shaped, cylindrical or prisma-

tic sponges whose walls are frequently diversified by ridges and prominences. The skeletal framework is very regular and is composed of larger and smaller quadrate meshes situated one within the other. The framework is formed by bundles of slender spicules.—From Zittel.

HYDNOCERAS

Hydnoceras nodosum Hall — Plate 51, fig. 2.

15th Rep. N. Y. State Geol. 1898, p. 848, pl. 2, fig. 2.

Occurrence.—In the shaly sandstones in the 'Chemung group' in Cattaraugus County, N. Y.

PRISMODICTYA

Prismodictya prismatica (Hall) — Plate 53, fig. 6.

15th Rep. N. Y. State Geol. 1898, p. 823, pl. 17, fig. 1; pl. 21, figs. 1-6; pl. 42, fig. 6.

Occurrence.—In the upper beds of the 'Chemung group'; in great numbers in the light gray sandstone at Concord, Erie County, Pa.; also at Wellsville and Olean, N. Y., and at Warren, Pa.

Prismodictya allegania Hall — Plate 53, fig. 5.

15th Rep. N. Y. State Geol. 1898, p. 824, pl. 20, fig. 4.

Occurrence.—In the upper beds of the 'Chemung group' at Scio and Almond, Allegany County and at Ischua and Olean, Cattaraugus County, N. Y.

Prismodictya choanea Hall — Plate 53, fig. 3.

15th Rep N. Y. State Geol. 1898, p. 825, pl. 19, figs. 1-3; pl. 27, fig. 5; pl 35, fig. 6.

Occurrence.—In the upper beds of the 'Chemung group' at Ischua and Olean, N. Y.

Prismodictya conradi Hall — Plate 52, fig. 4.

15th Rep. N. Y. State Geol. 1898, p. 831, pl. 18, fig. 4; pl. 19, figs. 5, 6.

Occurrence.—In the upper beds of the 'Chemung group' at Randolph, N. Y.

CLATHROSPONGIA

Clathrospongia abacus Hall **Plate 52, figs. 1-3.**

16th Rep. N. Y. State Geol. 1899, p. 345, pl. 49, figs. 5, 6.

Occurrence.—In the sandstone of the Waverly group, associated with *Ectenodictya implexa* and an undetermined *Spirifer* or *Syringothyris,* at Warren, Pa.

THYSANODICTYA

Thysanodictya expansa Hall **Plate 51, fig. 1.**

16th Rep. N. Y. State Geol. 1899, p.346 , pl. 53, fig. 3.

Occurrence.—In the sandstone of the Waverly group at Warren, Pa.

Thysanodictya randalli (Hall) **Plate 51, fig. 4.**

15th Rep. N. Y. State Geol. 1898, p. 869, pl. 24, fig. 12.

Occurrence.—In the 'Chemung group' associated with *Spirifer disjunctus* at Warren, Pa.

CALATHOSPONGIA

Calathospongia carlii Hall **Plate 52, fig. 5.**

16th Rep. N. Y. State Geol. 1899, p. 350, pl. 52, figs. 4, 7, and text fig. 21.

Occurrence.—"In the sandstone of the Waverly group found loose on the flats of Oil Creek, Pa. near the mouth of Pine Creek. The stream here cuts down about 15 feet below the 'Berea grit' " letter from Mr. Carll to James Hall. This species is also found near Pleasant Valley, Venango County, Pa. This species also occurs in the same rocks at Warren, Pa.

Calathospongia redfieldi (Hall) **Plate 53, figs. 1, 2.**

16th Rep. N. Y. State Geol. 1899, p. 347, pl. 48, figs. 1, 2; pl. 49, figs. 1-4.

Occurrence.—"This specimen upon which the original description was based was collected near Harrisville, Medina County, Ohio, in a yellow sandstone of the Waverly group. It has also been found in the Cuyahoga shale of the Waverly group at Akron, Ohio, and at Richfield, Ohio, and also in the Waverly sandstone on Nelson's farm near Pleasant Valley, Venango County, Pa.

TYLODICTYA

Tylodicta warrenensis Hall **Plate 53, fig. 4.**

16th Rep. N. Y. State Geol. 1899, p. 343, figs. 18, 19, 20.

Occurrence.—In the Waverly sandstone at Warren, Pa.

Tylodicta (?) tenuis (Hall) **Plate 51, fig. 3.**

16th Rep. N. Y. State Geol. 1899, p. 344, pl. 53, figs. 4, 5.

Occurrence.—In the Waverly sandstone at Warren, Pa.

ECTENODICTYA

Ectenodictya implexa Hall Plate 51, fig. 5.

16th Rep. N. Y. State Geol. 1899, p. 356, pl. 54, figs. 3, 4.

Occurrence.—In the Waverly group at Warren, Pa. where it is associated with *Syringothyris angulata;* found also in the same formation at Oil City, Pa.

ARTHROPODS

TROPIDOCARIS

Tropidocaris bicarinatus Beecher Plate 54, figs. 1, 3, 4, 6, 7, 9, 10.

2nd. Geol. Surv. of Pa. Vol. PPP. 1889, p. 16.
Geol. Journ. Vol. 58, 1902, p. 445, pl. 19, figs. 1-5.

Occurrence.—In the shales at the base of the 'Chemung group' as exposed at Warren, Pa.

Tropidocaris interrupta Beecher Plate 59, fig. 3.

2nd Geol. Surv. of Pa. Vol. PPP, 1884, p. 18.
Pal. of N. Y. Vol. VII, p. 185, pl. 31, fig. 15.

Occurrence.—In soft shales belonging to the Chemung as expressed at an elevation of 300 feet above the Allegany river at Warren, Pa.

Tropidocaris alternata Beecher Plate 59, figs. 4, 5.

2nd. Geol. Surv. of Pa. Col. PPP, 1884, p. 19.
Geol. Journ. Vol. 58, 1902, p. 447, pl. 19, fig. 6.

Occurrence.—In the sandstones of the Waverly group at Warren, Pa. associated with numerous species of Brachiopods, Pelecypods, and Gastropods.

ECHINOCARIS

Echinocaris socialis Beecher Plate 55, figs. 4, 6-8.

2nd. Geol. Surv. of Pa. Vol. PPP, 1884, p. 10.
Geol. Journ. Vol. 58, 1902, p. 441, pl. 17; pl. 18, figs. 1-7.

Occurrence.—In the shales at the base of the 'Chemung group' as exposed at Warren, Pa.

Echinocaris clarkii Beecher Plate 54, fig. 5.

Geol. Journ. Vol. 58, 1902, p. 443, pl. 18, fig. 9.

Occurrence.—In the shales of the Waverly group at Warren, Pa.

Echinocaris randalli Beecher — Plate 55, fig. 5.
Geol. Journ. Vol. 58, 1902, p. 443, pl. 18, fig. 8.

Occurrence.—In the sandstones and shales of the Waverly group at Warren, Pa.

ELYMOCARIS

Elymocaris siliqua Beecher — Plate 54, figs. 2, 8.

2nd. Geol. Surv. of Pa. Vol. PPP, 1884, p. 13.
Geol. Journ. Vol. 58, 1902, p. 447, pl. 19, figs. 7, 8.

Occurrence.—In the lower arenaceous and micaceous shales of the 'Chemung group' as exposed at Warren, Pa.

STYLONURUS

Stylonurus beecheri (Hall) — Plate 55, fig. 3.

Mem. N. Y. State. Mus. No. 14, 1902, p. 310.
Pal. of N. Y. Vol. VII, 1888, pl. 27, fig. 5.

Occurrence.—In the sandstones of the 'Chemung group' at Warren, Pa.

PRESTWICHIA

Prestwichia randalli Beecher — Plate 59, fig. 6.

Am. Geol. Vol. 29, 1902, p. 143, fig. 1.

Occurrence.—In the sandstone of the 'Upper Chemung' group near Ackley Station, Warren County, Pa.

EURYPTERUS

Eurypterus pennsylvanicus C. E. Hall — Plate 59, fig. 7.

2nd. Geol. Surv. of Pa. Vol. PPP, 1884, p. 31.

Occurrence.—In an arenaceous shale at the Rooker farm, Pithole, Venango County, Pa.

DALMANITES

Dalmanites (?) sp. — Plate 59, figs. 10, 11.

In the Oswayo beds at Flat Iron Station near Olean, Rock City, N. Y. the impression of the pygidium of a trilobite was found. Due to the coarseness of the matrix little could be de-

termined from the specimen aside from the fact that the pygidium was fringed as it is in some *Dalmanites*.

PROTOLIMULUS

Protolimulus eriensis (Wms.) Plate 55, figs. 1, 2.

Prestwichia eriensis Williams, Am. Jour. of Sci. Vol. 29, No. 173, p. 45, 1885.
Protolimulus eriensis Packard, Mem. Nat. Acad. Sci. p. 137, figs. 11-13
Protolimulus eriensis, Hall, Pal. N. Y. VII, p. 153, pl. 27, figs. 1, 2, 1888.

The original specimen of this species was discovered by C. L. Prosser in LeBoeuf, Erie County, Pennsylvania. The horizon according to Professor Williams' original description was "The Chemung group upper Devonian, the same bed [illegible] by I. C. White, 2nd Pa. Survey."

The dimensions of the original specimen were:

Total length	10	cm.
Greatest width	5.7	cm.
Length of telson (about)	4	cm.
Length of buckler (about)	2.	cm.
Greatest thickness of telson	7	cm.

Our specimen while undoubtedly a [illegible] is too fragmentary to make specific identification certain. The eight longitudinal ridges are the most outstanding character; these together with the arched cardial margin of the gnathopods were the primary characters for reference. The opisthosoma together with its genal spines has been broken off and the upper of the gnathopods much eroded. There seems to be a trace of the anchylosed primary segments of the thorax and a portion of the flat median depression between the anchylosed segments. The marginal spines of the telson and the latter have been eroded. The length of the fragment is 3.5 mm. and the width 7. mm.

Occurrence.—The specimen was found in the quarry of the ceromic plant at Lewis Run, Pa., southeast of Bradford Pa. The matrix is of a greenish brown color and contains fish remains in abundance.

VERTEBRATES

FISHES

CTENACANTHUS

"Les **Ctenacanthus** sont d'immense rayons tres-comprimés, à base large, mais a cavite plus petite que celle des **Oracanthus.** La partie de ses rayons cachée dans les chairs parait avoir été considerable. Au bord posterior se voient quelques petites épines. La surface est ornée de striés longitudinales, plus raprochees que celles de **Hybódes,** pectinées, c'est-a-dire crenelées transversalement et saillaintes en forme de dents qui alternent d'une serie a l' autre, mais qui semblent continuer a cause de leur obliquité."—Agassiz.

Dorsal fin spines; robust, often attaining a large size, laterally compressed; sides of exserted portion ornamented with longitudinal ridges, usually crenulated or denticulated, rarely smooth; posterior face flat or concave, with a series of small denticles upon each margin.

Dr. Newberry suggested that *Ctenacanthus* and *Orodus* might be synonymous, having found them together in the Waverly shales of Ohio. The British Museum catalog states that it is noteworthy that the largest spines of *Ctenacanthus* occur in the Bristol Carboniferous Limestone where are also found the largest teeth of *Orodus.*

The following list of *Ctenacanthus* have been described from North American Devonian and Carboniferous formations. It may be helpful in attempting specific identification of any forms found in the Bradford and Warren areas.

Pal. III. V, II, 1866, p. 118. Chester Limestone, Ill.

C. angulatus, Newb. and Worth.

C. angustus Newb.
Mo. U. S. G. S. No. 16, 1889, p. 181; Berea grit, Berea, Ohio.

C. burlingtonensis St. John and Worth.
Pal. III. V, VI, 1875; Upper Burlington limestone, Ill. and Ind.

C. buttlersi St. John and Worth.
Pal. III. Op. Cit. V, VII; Lower coal measures of Ill.

C. cannaliratus St. John and Worth.
Pal. Ill. Op. Cit. Chester Limestone, Ill.

C. chemungensis Claypole.
Mem. N. Y. State Mus. No. 10, 1907, p. 77. Chemung group of N. Y.

C. clarki Newb.
Mon. U. S. G. S. No. 16, 1889, p. 168; Cleveland shales, Berea, Ohio.

C. compressus Newb.
Mon. U. S. G. S. No. 16, 1889, p. 168; Cleveland and shale, Ohio.
C. coxianus St. John and Worth.
Pal. Ill. V, VII, p. 233; Keokuk Limestone, Ill.
C. cylindricus, Newb.
Mon. U. S. G. S. No. 16, 1889, p. 202; Keokuk limestone and shale, Kty.
C. deflexus St. John and Worth.
Pal. Ill. V, VII, St. Louis limestone, Ill.
C. elegans Toumey
Geol. of Alabama, 1858, p. 38; Lower carboniferous.
C. excavatus St. John and Worth.
Pal. Ill. V, VI, p. 428; Keokuk limestone of Ia. and Mo.
C. formosus Newb.
Geol. Surv. of Ohio, V, I, pt. II; Waverly group, Ohio and Kty.
C. furcicarinatus Newb.
Geol. Surv. of Ohio, V, I, pt. II, Waverly group, Ohio.
C. gemmatus St. John and Worth.
Pal. Ohio, V, VI, p. 429; St. Louis limestone, Ill.
C. gracillimus Newb and Worth.
Pal. of Ohio, V, VI; St. Louis limestone.
C. gradacostata St. John and Worth.
Pal. Ohio, V, VI, p. 425; Upper Burlington limestone, Ia. and Ill.
C. harrisoni St. John and Worth.
Pal. of Ohio, V, VII, p. 236; St. Louis limestone, Ill.
C. keokuk St. John and Worth.
Pol. of Ohio, V, VI, p. 427; Keokuk limestone of Ill. Ia. and Mo.
C. littoni Newb.
Mon. U. S. G. S. No. 16, 1889, p. 201; St. Louis limestone, Mo.
C. marshi Newb.
Geol. Surv. of Ohio, V, I, pt. II, p. 326; Coal Measures, Ohio.
C. mayi Newb. and Worth.
Pal. of Ill. V, IV, 1870, p. 370; Lower Cab. limestone, Ia.
C. parvulus Newb.
Pal. of Ohio, vol. II.
C. pellensis St. John and Worth.
Pal. Ill. V, VII, p. 237; St. Louis limestone, Ia.
C. pugiunculus St. John and Worth.
Pal. Ill. V, VI, p. 430; St. Louis limestone, Mo.
C. randalli Newb.
Mon. U. S. G. S. No. 16, p. 105; Olean conglomerate, Warren, Pa.
C. sculp.us St. John and Worth.
Pal. of Ill. V, VI, p. 421; Kinderhook limestone, Ia.
C. similis, St. John and Worth.
Pal. Ill. V, VI, p. 431; Chester limestone, Ill.
C. speciosus St. John and Worth.
Pal. Ill. V, VI, p. 424; Kinderhook limestone, Ia.
C. spectabilis St. John and Worth.
Pal. Ill. V, VI, p. 420; Kinderhook limestone, Ia.
C. triangularis Newb.
Geol. Surv. V, I, 1873, p. 329; Waverly group, Warren, Pa.
C. varians St. John and Worth.
Pal. Ill. V, VI, p. 422; Kinderhook limestone, Ia.
C. vetustus Newb.

Geol. Surv. Ohio, V, I, pt. I, p. 326; Huron shales of Ohio.
C. wrighti Newb.
Mon. U. S. G. S. No. 16, 1889. p. 66; Hamilton group, N. Y.
Ctenacanthus randalli Newb.
Mon. U. S. G. S. No. 16, 1889, p. 105, not pictured.

Dorsal spine 12 inches long, 1½ inches wide at base of ornamentation; backward curving, laterally compressed, basal portion conical, smooth or finely striated longitudinally. Line of demarcation between the ornamented surface and the base strongly marked. Ornamented surface near the base formed by about 40 fine parallel sub-equal, finely crowded ribs on each side of the median line. These bear small rounded closely approximated tubercles.

Occurrence.—Originally found in the Olean conglomerate (Pocono), two miles northeast of Warren, Pa. Several other specimens have been found in this vicinity but never have been illustrated.

Ctenacanthus chemungensis Claypole — **Plate 56, fig. 9.**

Mem. N. Y. State Mus. No. 10, 1907, p. 77, pl. 7, fig .3.

The spines are small, narrow and finely ornamented. The length is less than 10 mm. Costæ thread-like. Surface of impression punctate.

Occurrence.—Collected by Beecher and others from the Chemung beds in Warren County, Pa. Other specimens have been found in the Chemung beds between Friendship and Nile, N. Y.

Ctenacanthus triangularis Newb. — **Plate 56, figs. 1, 2.**

Pal. of Ohio, I, 1873, p. 329, pl. 36, figs. 1, 1a.

The illustration shows the characters of this species sufficiently well. They are usually 4 to 6 inches long.

Occurrence.—More than a dozen specimens were found on a slab of sandstone detached from a cliff below the conglomerate on the bank of Oil Creek, Pa. With these specimens were also found several teeth too poorly preserved to identify. One of the teeth had, however, somewhat the form of those of *Acrodes* and might be considered a tooth of *Orodus* but the others are more

like those of *Psammodus*. The horizon is Waverly.

Ctenacanthus harrisi, n. sp. Plate 57, fig. 1.

Dorsal spine represented by a fragment 13 cm. long; probably at least 18 cm. long in life. The width along the line of insertion is about 6 cm.; thickness at posterior point of insertion 27 mm. Spine curves slightly posteriorly, laterally flattened, posteriorly invaginated; the depth of the invagination at the point of insertion of the spine being a little over one-half the thickness of the spine.

The line of separation between the ornamented surface and the inserted portion is very oblique and slightly convex. The inserted portion of the spine is longitudinally striate, the striæ becoming regularly imbricated.

The ornamentation of the external surface consists of about 40 longitudinal costæ (about 19 or 20 on each side of the median-line) which are much elevated and are separated from each other by sulci which are slightly narrower than the width of one ridge. The ridges in the front part of the spine are the widest. The 8 posterior lateral costæ bifucate just before reaching the line of insertion.

Each elevated ridge bears many well developed square or slightly transverse tubercles. There are from 12 to 14 of these to a cm. They are spaced from each other about the width of one tubercle.

The ribs are less numerous than in *C. randalli* and the tubercles are differently spaced and shaped. The ribs are closer together than in *C. tenuistriatus* which *C. harrisi* approaches in the number of ribbs and shape of tubercles. *C. harrisi* differs from *C furc carinatus* in the character of the tuberculation and the number of bifurcating costæ.

This spine is named in honor of Prof. G. D. Harris of Cornell University who discovered the specimen.

Occurrence.—One mile east of Mt. Jewett, Pa., on the Roosevelt highway, at a rock cut through which the road passes. The beds are about 50 feet below the white quartzitic conglomerate which outcrops over a large area on the hill top at Mt. Jewett. The matrix is a brown sandy material which contains an abundance of flattened clay pellets and frequently coarse pebbles.

Associated with the fish remains was an abundance of plant remains and a fauna among which were: *Syringothyris angulata, Spirifer disjunctus, Leptodesma mentor,* var. *maxima, Camarotoechia* sp., etc. The horizon is quite probably Mississippian.

HOLONEMA

Holonema rugosa (Claypole) Plate 56, fig. 3.

Mon. U. S. G. S. No. 16, 1889, p. 93, pl. 17, figs. 1-4.

The surface ornamentation of a Placaderm which consists of raised enamel lines which are often simple and parallel but more frequently broken and tortuous.

Occurrence.—In the Chemung rocks at Franklin, Delaware County, N. Y., at LeRoy, Bradford County, Pa., and in the Catskill rocks of north-central Pa. The illustrated specimen came from below the second conglomerate at Bradford, Pa.

DINICHTHYS

Dinichthys tuberculatus Newb. Plate 56, fig. 5.

Mon. U. S. G. S. No. 16, 1889, p. 98, pl. 37, fig. 3.

The plates of this species are very thick, often attaining one-half to one-quarter inch in thickness.

Occurrence.—In the fish beds of the Chemung conglomerate at Warren, Pa. This same species occurs also according to Dr. Newberry, in the *Psamile de Condroz,* the correlate of our Chemung, near Liege, Belgium.

HOLOPTYCHUS

Holoptychus (Sauripteris?) taylori (Hall) Plate 57, fig. 2.

Geol. of the 4th Dist. of N. Y. State, 1843, p. 282, Ill.

Occurrence.—Originally described from the Catskill group at Blossburg, Pa. The illustrated specimens came from the Chemung beds at Bradford, Pa. and is referred with hesitation to this species.

Holoptychus americanus Leidy Plate 57, fig. 5.

Mon. U. S. G. S. No. 16, 1889, p. 113, pl. 19, figs. 12, 13.

Occurrence.—The Catskill rocks of N. Y. and Pa.; not common. Reported from between the Wolf Creek and Salamanca conglomerates by Butts.*

*Bul. N. Y. State Mus. No. 69, p. 994.

Holoptychus (?) pustulosus Newb. Plate 56, fig. 10.

Mon. U. S. G. S. No. 16, 1889, p. 100, pl. 20, figs. 11, 11a.

Thick bony scales which are round, ovoid or elliptical; usually not over 2 by 1½ inches in size; central portion coarsely tuberculate. Exact relationship not known.

Occurrence.—Found in the 'Chemung group' at Warren, Pa.

GANORHYNCHUS

Ganorhynchus beecheri Newb. Plate 56, fig. 6.

Mon. U. S. G. S. No. 16, 1889, p. 95, pl. 19, fig. 2.

Occurrence.—The Chemung and Catskill beds at Warren, Pa.

DIPTERUS

Dipterus (Ctenodus) clabelliformis Newb. Plate 58, figs. 10, 16.

Mon. U. S. G. S. No. 16, 1889, p. 90, pl. 27, figs. 21, 21a.

Occurrence.—Found in the 'Chemung group' at Warren, Pa.

Dipterus (Ctenodus) nelsoni Newb. Plate 58, figs. 1, 11.

Mon. U. S. G. S. No. 16, 1889, p. 89, pl. 27, figs. 19, 20.

The teeth of this species are distinguishable from the teeth of other *Ctenodus* by the strong sub-arcuate ridges, the edges of which are highly polished. In some forms the teeth are without any ridges; and in younger forms the ridges are often with undulations and almost tuberculate.

Occurrence.—In the 'Chemung group' at Warren, Pa.

Dipterus (Ctenodus) levis Newb. Plate 58, figs. 15.

Mon. U. S. G. S. No. 16, 1889, p. 90, pl. 27, figs. 22.

Four or five short ridges which are usually smooth and polished. The central portion is plain.

Occurrence.—In the 'Chemung group' at Warren, Pa.

Dipterus (Ctenodus) quadratus Newb. Plate 13, figs. 13, 14.

Mon. U. S. G. S. No. 16, 1889, pl. 27, figs. 24, 25.

Occurrence.—In the 'Chemung group' at Warren, Pa .

Dipterus (Ctenodus) minutus Newb. Plate 58, fig. 15.

Mon. U. S. G. S. No. 16, 1889, p. 91, pl. 27, figs. 26.

Occurrence.—In the 'Chemung conglomerate' at Warren, Pa.

RHADINICHTHYS

Rhadinichthys (?) sp. Eastman Plate57,figs.3,6.

Mem. N. Y. State Mus. No. 10, 1907, p. 172, pl. 4, fig. 11; pl. 9, fig. 4.

Occurrence.—In the 'Chemung group' at Warren, Pa.

BOTHRIOLEPIS

Bothriolepis minor Newb. **Plate 57, fig. 4.**

Mon. U. S. G. S. No. 16, 1889, p. 112, pl. 20, fig. 7.

Occurrence.—The 'Chemung group' at LeRoy, Bradford County, Pa. and reported by Mr. C. Butts (N. Y. State Mus. Bul. 69, p. 994.) from between the Wolf Creek and Salamanca conglomerates.

HOMACANTHUS

Homacanthus acinaciformis East. **Plate 58, fig. 3.**

Me. N. Y. State Mus. No. 10, 1907, p. 75, pl. 1, fig. 16.

The small size, slenderness, gentle curvature and lateral ridges, together with the aciculate posterior denticles characterize this species.

Occurrence.—In the Chemung group' at Warren, Pa.

APEDODUS

Apedodus priscus Leidy **Plate 58, figs. 4, 5.**

Mon. N. Y. State Mus. No. 10, 1907, p. 166, pl. 1, figs. 1, 2.

Occurrence.—In the 'Chemung beds' at Warren, Pa.

GYRACANTHUS

Gyracanthus sherwoodi Newb. **Plate 58, figs. 7, 8.**

Mon. U. S. G. S. No. 16, 1889, p. 119, pl. 20, figs. 4, 4a.

Occurrence.—In the Catskill beds of Cattaraugus County, N. Y. and Tioga County, Pa. and reported by Mr. C. Butts (Bul. N. Y. State Mus. No. 69, p. 994) from between the Wolf Creek and Salamanca conglomerates.

SAGENODUS

Sagenodus sp. Eastman **Plate 58, fig. 12.**

Mon. N. Y. State Mus. No. 10, 1907, p. 160, pl. 1, fig. 13.

Occurrence.—In the 'Chemung beds' at Warren, Pa.

CLADODUS

Cladodus carinatus Newb.

Mon. U. S. G. S. No. 16, 1889, p. 103, not illustrated.

Occurrence. This is a rather indefinite species occurring

among many other indefinable fragments at Warren, Pa. in what Dr. Newberry termed the 'Fish beds'.

HELIODUS

Heliodus gibberulus Ag.

Mon. U. S. G. S. No. 16, 1889, p. 102, not illustrated.

This species was originally described from the Carboniferous limestones of Ireland and specimens very close to this species have been collected on the Miller farm in the Waverly beds on Oil Creek, Pa. None of the Pennsylvania specimens seem to have ever been pictured.

Helodus comptus Eastman

Ann. Carneg. Museum. Pittsburg, Vol. V, 1909, p. 488.

This species is known only from teeth which were discovered in the upper limestone (base of the Waverly) at Meadville, Penna. This species seems to have never been illustrated.

AMPHIBIANS

THINOPUS

Thinopus antiqus Marsh Plate 59, figs. 8, 9.

Am. Journ. of Sc. vol. 2, 1892, p. 374, Ill.
Am. Journ of Sc. (5) 71; voll. 12, p. 409, Ill.

This foot-track from the upper Devonian is the earliest stratigraphic record yet discovered of vertebrate life higher than fishes. Previous to this discovery the remains of Amphibians from the Carboniferous beds were the earliest known records of terrestrial vertebrates.

For an able discussion of the significance of this track and a reconstruction of the Amphibian foot see the paper by Mr. D. J. Morton, the second reference cited above.

Occurrence.—Found in the town of Pleasant, one mile south of the Allegany river, Warren County, Pa. The geological horizon is near the top of the 'Chemung group' in the Devonian. In the same beds are ripple marks, mudcracks and impressions

of rain drops, indicating shallow water and shore deposits. Land plants are found in the same general horizon. Marine mollusks a'so occur, and one characteristic form, (*Nuculana*) is preserved in the foot-print slab.—From Marsh.

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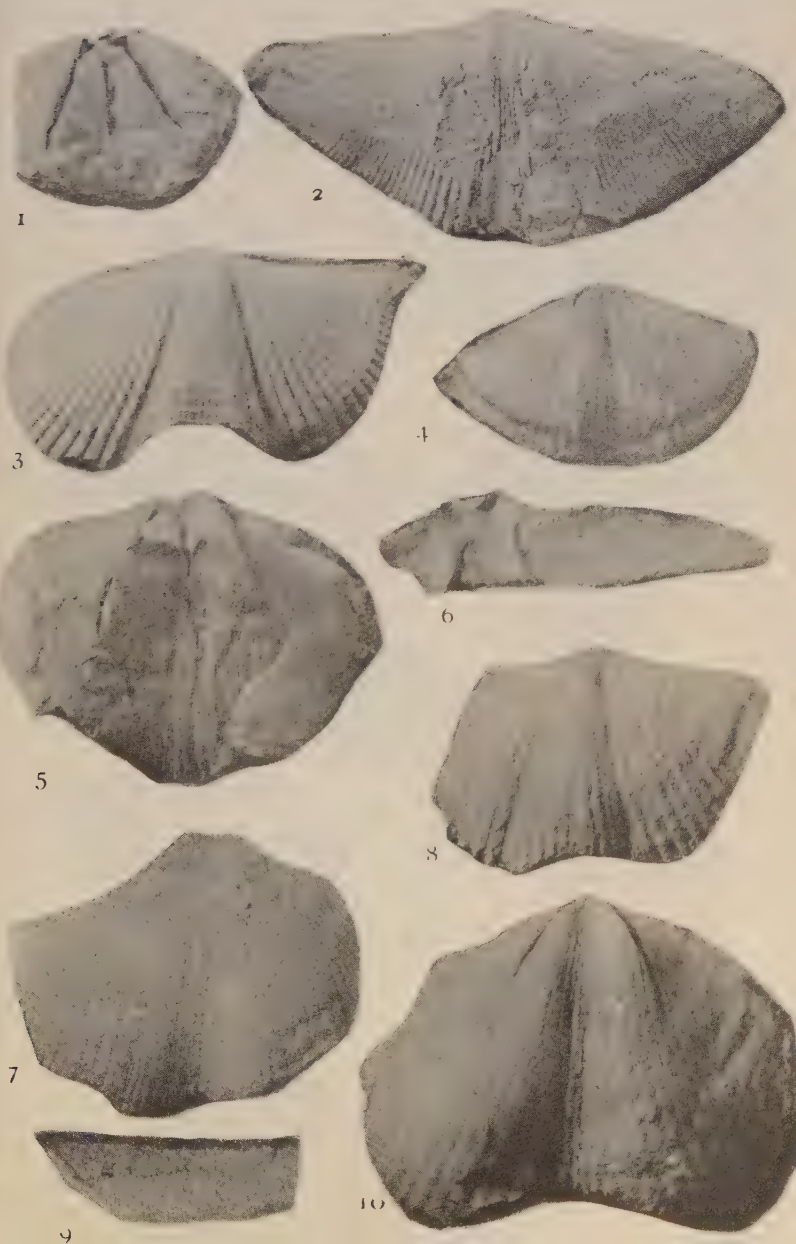
EXPLANATION OF PLATE 2 (23)

FIGURE

1. **Reticularia præmatura** (Hall). From the Oswayo formation (?) ¾ miles east of the monument at Cobham, Pa. Width 37 mm. P. 59.
2. **Spirifer disjunctus** Sowerby. Chemung beds at Black Creek, Hudson tp. Allegany co. N. Y. nat size. P. 27.
3. **Spirifer disjunctus** Sowerby. Buff colored sandstone from the Venango First Oil Sand horizon near Glade, Pa. nat. size.
4. **Spirifer disjunctus** Sowerby. Same horizon as Fig. 3; 3 miles southwest of Warren, Pa. 31 mm. wide.
5. **Reticularia præmatura** (Hall). Showing the large muscular impression. The Owayo formation ¾ miles east of Glade, Pa.
6. **Spirifer disjunctus** Sowerby. Internal pedicle valve. From the Venango First Oil Sand at Glade, Pa. Width 52 mm.
7. **Spirifer disjunctus** Sowerby. Buff colored sandstone 100 feet above the road at Glade, Pa. nat. size.
8. The same from the same faunule as fig. 7. nat. size.
9. **Spirifer disjunctus** Sowerby. External cast of a portion of the cardinal area. Same faunule as Fig. 7. Length of specimen 16 mm.
10. The same from the horizon of Fig. 6, 3 miles southeast of Warren, Pa.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EXPLANATION OF PLATE 3 (24)

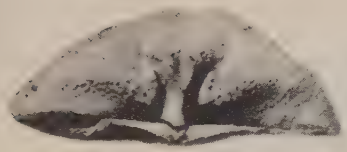
FIGURE

1. **Reticularia præmatura** (Hall)?. Three-fourths of a mile east of the monument at Cobham, Pa. Matrix a buff sandstone. Width 40 mm. P. 59.
2. **Spirifer disjunctus** Sowerby. From the Oswayo at Glade, Pa. With of Specimen 25 mm. P. 27.
3. The same. From the Conewango formation at Glade, Pa. Width 33 mm.
4. The same. From the middle Conewango formation at Pope Hollow, N.Y. nat. size.
5. **Spiri er disjunctus** Sowerby. From the same faunule at Fig. 2. Width 45 mm.
6. The same. The Venango First Oil Sand horizon just east of the Cobham monument. Width 36 mm.
7. **Cyrtia alta** (Hall) same faunule as Fig. 3. Width 40 mm. P. 52.
8. **Reticularia præmatura** (Hall). Same faunule as Fig. 1. nat size.
9. **Spiri er disjunctus** Sowerby. Ventral view of Fig. 3.
10. The same. Same faunule as Fig. 2. Width of specimen 33 mm.

EXPLANATION OF PLATE 4 (25)

FIGURE

1. **Spirifer allegheniensis** n. sp. 'Venango first oil sand,' Stone Hill, near Stoneham, Pa. Width 32 mm. P.
2. **Spirifer allegheniensis** n. sp. Showing internal coils. Same faunule as Fig. 1. Width 36 mm.
3. **Spirifer allegheniensis** n. sp. Same faunule as Fig. 1. Width 34 mm.
4. **Spirifer allegheniensis** n. sp. Dorsal view of Fig. 3.
5. **Spirifer allegheniensis** n. sp. Same faunule as Fig. 1. Width 29 mm.
6. **Spirifer allegheniensis** n. sp. Width 35 mm.
7. **Spirifer disjunctus** var. **sulcifer** Hall. Locality same as for Fig. 1. Width 36 mm. P. 49.
8. Ventral view of Fig. 7.
9. **Spirifer allegheniensis** n. sp. Width 30 mm.
10. Ventral view of Fig. 9.
11. Dorsal view of Fig. 9.



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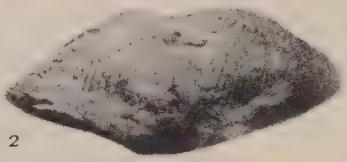

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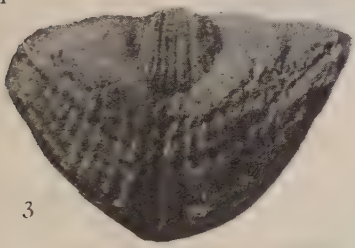

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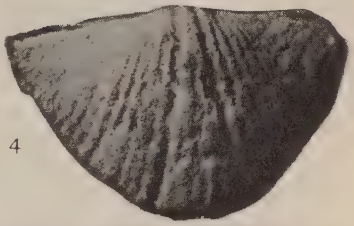

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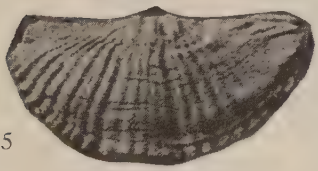

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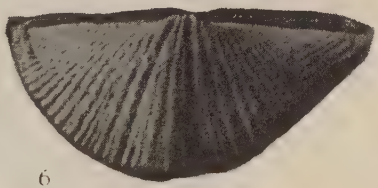

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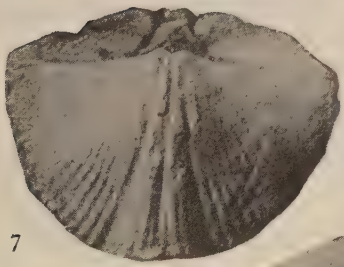

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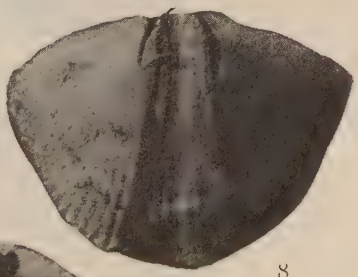

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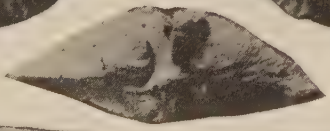

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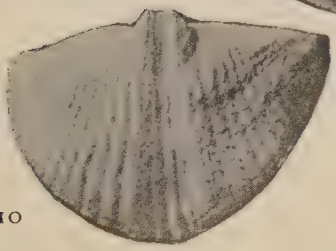

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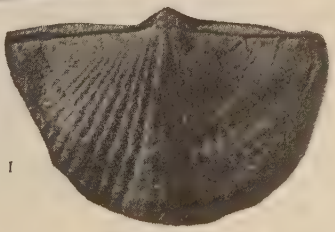

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EXPLANATION OF PLATE 5 (26)

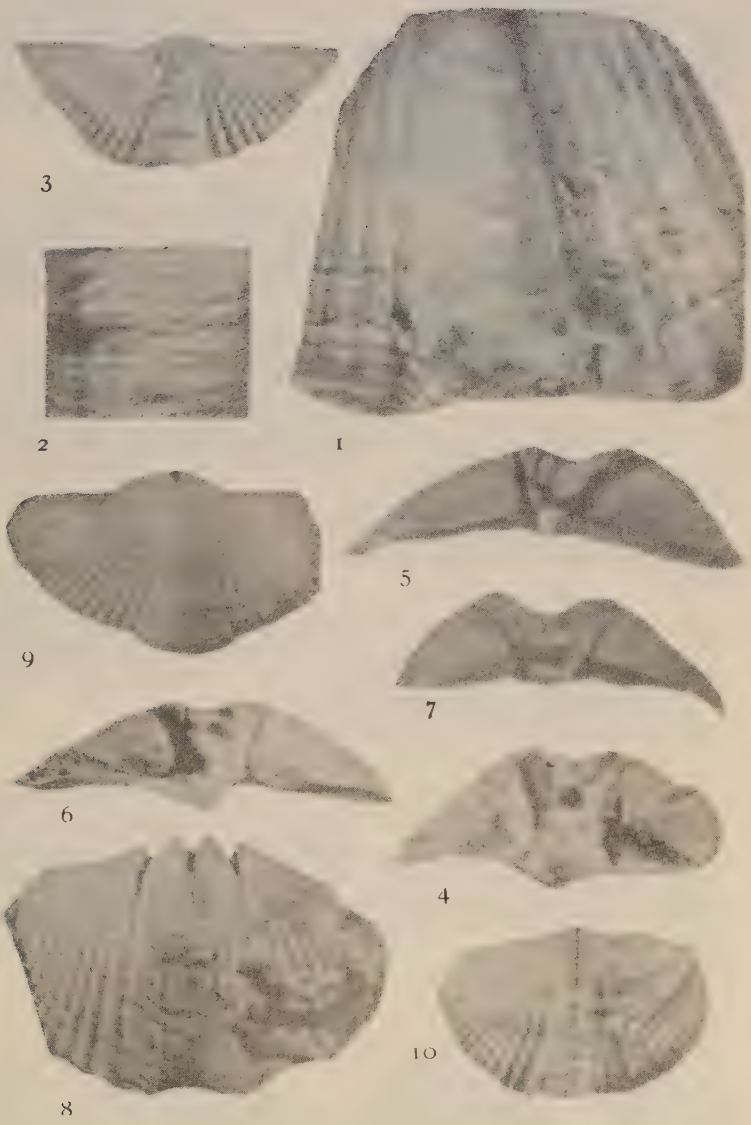
FIGURE

1. **Spirifer disjunctus** Sowerby. Showing the spiral coils. The upper Chemung beds at Black Creek, Allegany County, N. Y. Width 63 mm. P. 27.
2. **Syringothyris angulata** Simpson. Venango First Oil Sand; Stone Hill, near Stoneham, Pa. Width 50 mm. P. 52.
3. **Syringothyris randalli** Simpson. Original illustration for comparison with the type of **Syringothyris** found near Warren. From Tr. Am. Phil. Soc. n. s. 16, 1889, p. 441. P. 52.
4. **Syringothyris angulata** Simpson. A well developed muscular impression. Coarse pebble conglomerate associated with the Venango First Oil Sand at Stone Hill, near Stoneham, Pa., nat. size.
5. The same. Same faunule at Fig. 4. Width 36 mm.
6. **Spirifer disjunctus** Sowerby. Showing a strong peripheral impression. Basal Conewango at Stoneham, Pa. Width 41 mm.
7. **Reticularia præmatura** (Hall). Cardinal view of Fig. 5, plate 2.
8. **Spirifer disjunctus** Sowerby. Probably a pathologic specimen. P. 59.

EXPLANATION OF PLATE 6 (27)

FIGURE

1. **Syringothyris angulata** Simpson. P. 42.
1. Photomicrograph of an external cast showing the characteristic "twilled cloth" structure. Venango First Oil Sand on Stone Hill, near Stoneham, Pa.
2. Surface ornamentation under higher magnification.
3. **Syringothyris** ? sp. From the faunule of Fig. 1. Width 39 mm.
4. **Syringothyris angulata** Simpson. An unusually pustulose individual. From the faunule of Fig. 6. Width 38 mm.
5. The same. A specimen with a deformed syrinx. The same faunule as Fig. 1. nat. size.
6. A specimen showing an apparently solid syrinx. From the Venango First Oil Sand at Cobham, Pa.; approx. nat size.
7. A specimen showing the posterior mesial carina of the mold and the ventrally split syrinx. Two miles west of Smethport, Pa. Width 42 mm.
8. The syrinx of this specimen was evidently attached directly to the internal ventral surface of the shell. Same faunule as Fig. 6. Height of specimen about 32 mm.
9. **Spirifer disjunctus** ?. From above the Sub Olean conglomerate at Cobham, Pa.; nat size. P. 47.
10. **Spirifer disjunctus** Sowerby from the Venango First Oil Sand horizon one mile east of Stoneham, Pa.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EXPLANATION OF PLATE 7 (28)

FIGURE

1-12. Syringothyris angulata Simpson. P. 32.

1. Ventral valve of a specimen from the conglomerate associated with the Venango First Oil Sand at Stoneham, Pa. Width 45 mm.
2. From the same faunule as Fig. 1. Width 34 mm.
3. An interesting syringeal development. Width 42 mm.
4. Typical of many specimens from the faunule of Fig. 1.
5. One stage farther along than that shown by Fig. 1, in the ventral attachment of the syrinx. Width 47 mm.
6. Ventro-cardinal view of Fig. 5.
7. From the same faunule as Fig. 1. Width 50 mm.
8. From the Venango First Oil Sand horizon at Stoneham, Pa. Width 51 mm.
9. A mal-formed specimen from the faunule of Fig. 1. Width about 32 mm.
10. Cardinal view of Fig. 1.
11. From the same locality as Fig. 8. Width 48 mm.
12. A peculiar syrinx with an inverted T-shaped invagination on the ventral side. Faunule the same as for Fig. 1. Width 43 mm.

EXPLANATION OF PLATE 8 (29)

FIGURE

1-10. **Syringothyris angulata** Simpson. P. 32.

1-3. From the illustrations accompanying the original description of the species. Tr. Am. Phil. Soc., n. s. 16, 1889. p. 440.

4. From the Venango First Oil Sand at Stoneham, Pa. Width 30 mm.

5. An extreme development of the muscle impression. About a mile east of the Cobham monument, the same horizon as Fig. 4. Width about 42 mm.

6. A primitive syrinx which is split slightly toward the front. From the faunule of Fig. 4. Width 41 mm.

7, 8. From the faunule of Fig. 4. Nat. size.

9, 10. From the chocolate colored shales 2 miles west of Smethport, Pa., in a cut along the mountain on a spur railroad. Nat. size.

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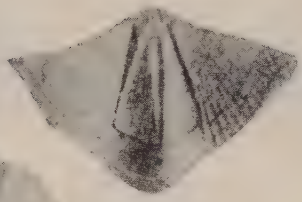

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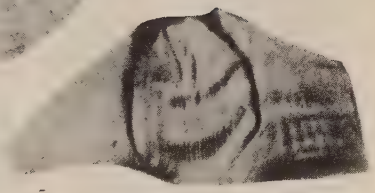

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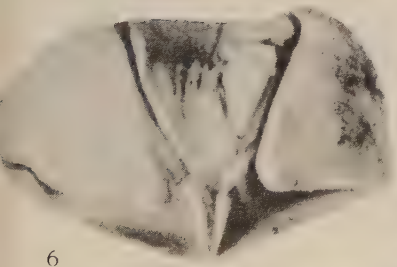

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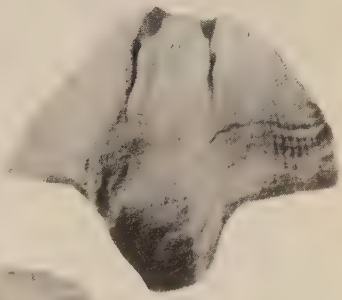

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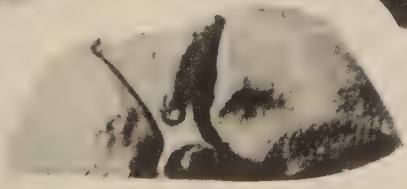

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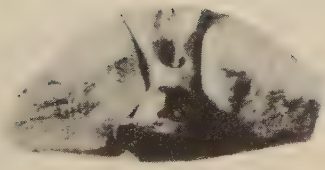

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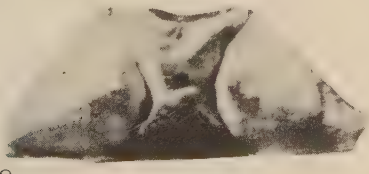

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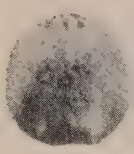
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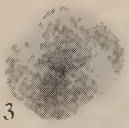
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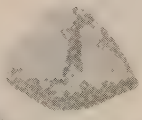
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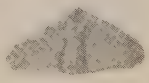
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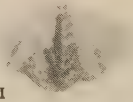
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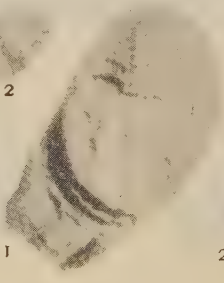
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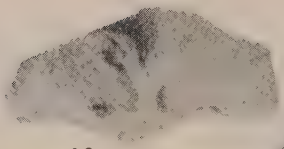
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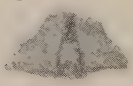
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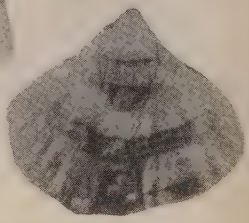
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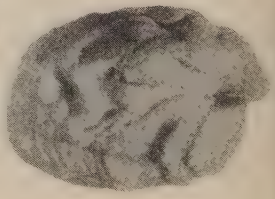
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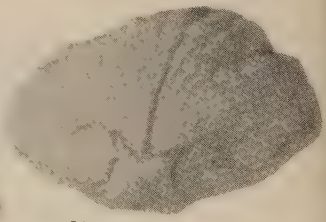
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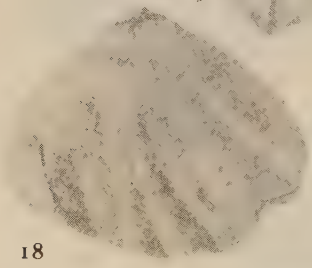
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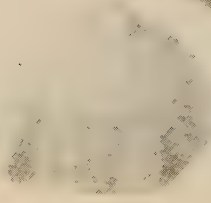
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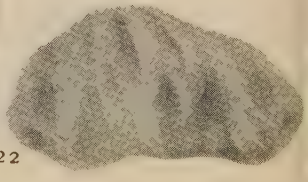
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EXPLANATION OF PLATE 9 (30)

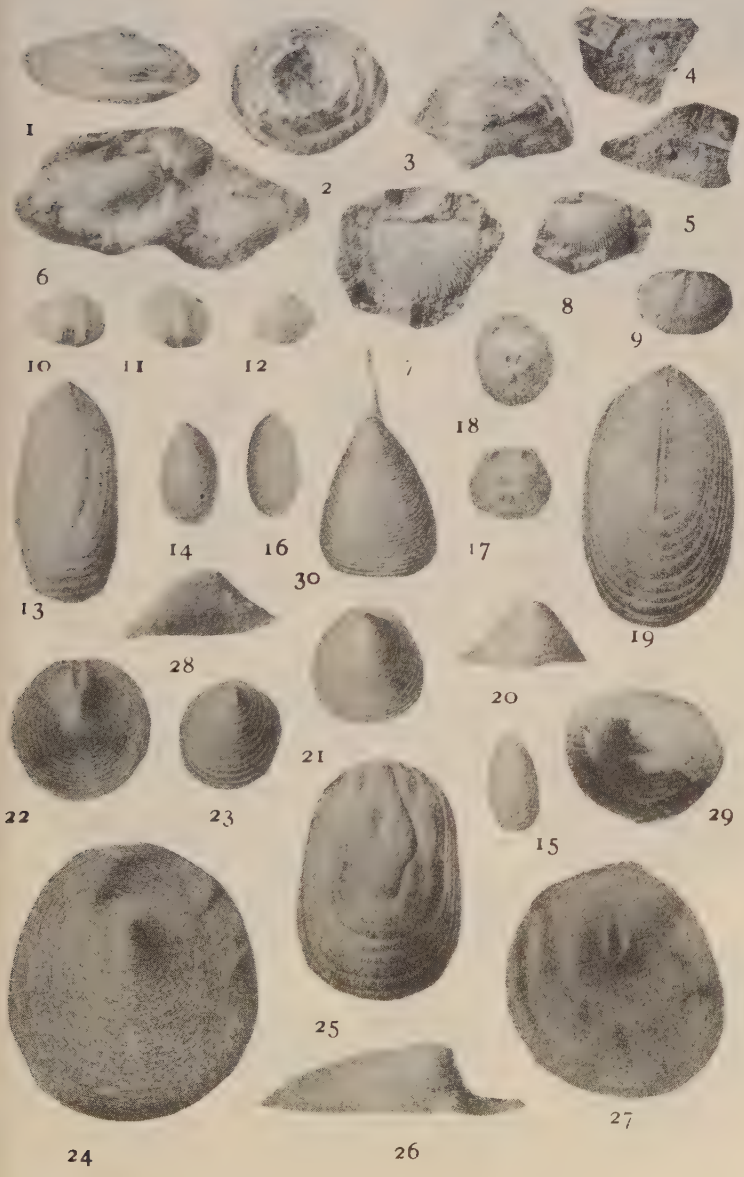
FIGURE

1. **Athyris angelica** Hall, nat. size. P. 35.
2. **Athyris angelica** Hall, nat. size.
3. **Athyris angelica** Hall. Venango First Oil Sand at Stone Hill, near Stoneham, Pa., nat. size.
4-12. **Cyrtina triplicata** Simpson. From the same faunule as Fig. 1, x 2. P. 19.
13. **Paraphorhynchus** sp. From the Venango First Oil Sand horizon at Cobham, Pa. P. 21.
14. **Paraphorhynchus medialis** (Simpson). From a conglomeritic sandstone at the Venango First Oil Sand horizon just east of the monument at Cobham, Pa. P. 22.
15. **Paraphorynchus girtyi**, n. sp. From Venango First Oil Sand horizon between Scania and Smethport, Pa. x7-5. P. 23.
16. **Paraphorhynchus striata** (Simpson). From the faunule of Fig. 1. Greatest width 36 mm. P. 24.
17-19. **Paraphorhynchus girtyi** n. sp. Different views of Fig. 15.
20. **Paraphorhynchus striata** (Simpson)? Same faunule as Fig. 1. Width 30 mm.
21. **Paraphorhynchus medialis** (Simpson). An enlargement of a portion of an external cast. Faunule of Fig. 1. P. 22.
22. **Paraphorhynchus girtyi**, n. sp. Another view of Fig. 15.

EXPLANATION OF PLATE 10 (31)

FIGURE

1. **Orbiculoidea** sp. Impression of an external cast from the Venango First Oil Sand 3 miles southeast of Warren, Pa. nat. size. P. 5.
2. **Orbiculoidea** sp. The external cast from which Fig. 1 was made.
3. **Orbiculoidea** sp. From the Oswayo sandy shales 2 miles west of Smethport, Pa. In a railroad cut. nat. size.
4, 5. **Orbiculoidea** sp. From the Venango First Oil Sand horizon at Glade, Pa.
6. **Chonetes setigerus** (Hall). From just above the Sub Olean conglomerate 1 miles east of Stoneham, Pa. x9-7. P. 8.
7. **Orthothetes crenistria** (Phillips?). From the Venango First Oil Sand horizon at Cobham, Pa. x 2., P. 7.
8. **Chonetes setigerus** (Hall). Same faunule as Fig. 6.
9. **Dalmanella leonensis** Hall ?. From the Conewango formation at Glade, Pa., slightly reduced. P. 8.
10. **Spirifer** sp. ?. From the Conewango formation near Warren, Pa. x1¼.
11, 12. **Ambocœlia gregaria** Hall. The same horizon as Fig. 6, and at Stoneham, Pa. x 1¼. P. 38.
13. **Lingula cuyhoga** Hall. From Pal. of N. Y., viii, i, 1892, pl. 1, fig. 18. P. 5.
14. **Lingula ligea** Hall. From Pal. of N. Y., iv, 1867, pl. 1, fig. 2a. P. 5.
15. **Idem** fig. 5.
16. **Idem** fig. 2.
17. **Crania leoni** Hall. From Pal. of N. Y., iv, 1867, pl. 3, fig. 30. P. 6.
18. **Idem** fig. 29.
19. **Lingula delia** Hall. From Pal. of N. Y., viii, i, 1892, pl. 1, fig. 29. P. 5.
20. **Crania leoni** Hall. Pal. of N.Y., iv, 1867, pl. 3, fig. 28.
21. **Lingulodiscina pleurites** (Meek). From Pal. of N. Y., viii, i, 1892, pl. 4e, fig. 23. P. 5.
22. **Idem** fig. 21.
23. **Idem** fig. 24.
24. **Orbiculoidea allegania** (Hall). From Pal. of N. Y., iv, 1867, pl. 1, fig. 17a. P. 5.
25. **Lingula scutella** Hall. From Pal. of N. Y., viii, i, 1892, pl. 1, fig. 30. P. 4.
26. **Orbiculoidea allegania** (Hall). Pal. of N. Y., iv., 1867, pl. 1, fig. 17b.
27. **Idem** fig. 17c.
28. **Crania** cf. **leoni** Hall. From the Oswayo sandstone, near Olean Rock City, N. Y. nat. size.
29. Another view of Fig. 28.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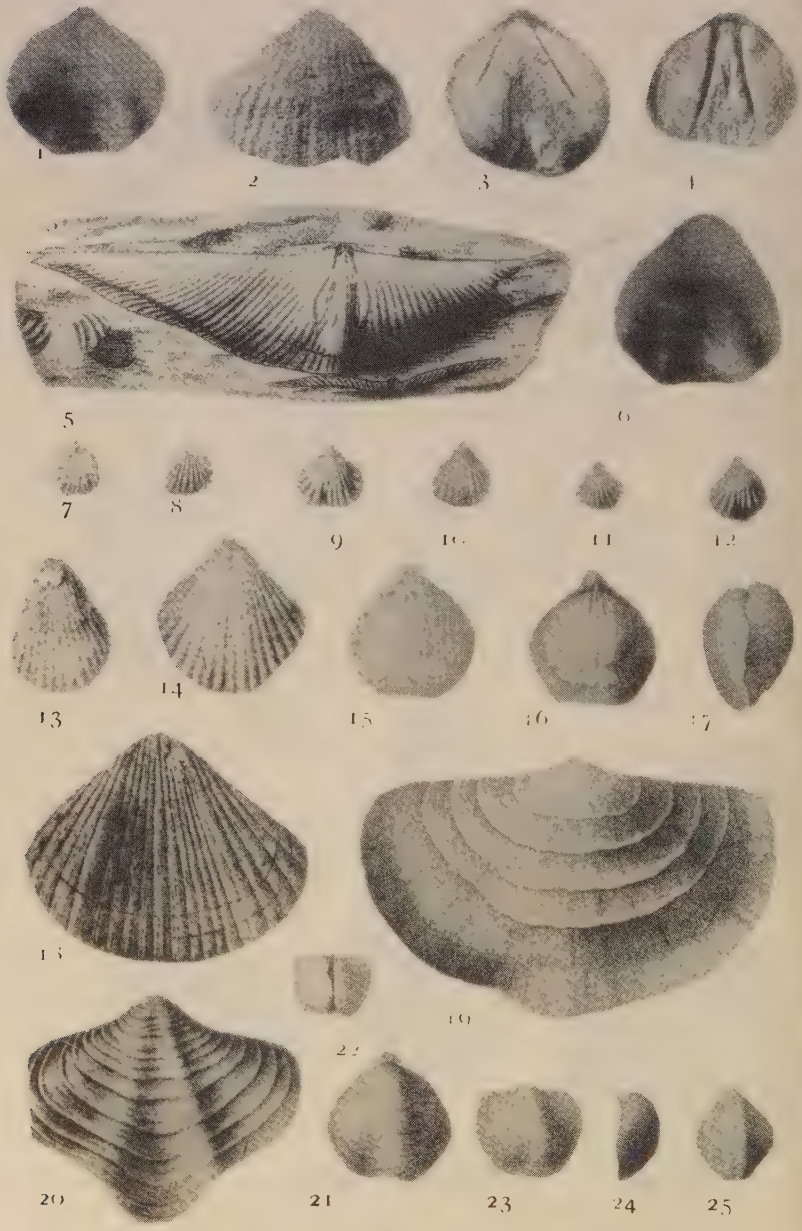
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EXPLANATION OF PLATE 11 (32)

FIGURE

1. **Athyris angelica** Hall. From the Cattaragus beds of Chautauqua county, N. Y. Width about 20 mm. P. 35.
2. **Rhynchospirina scansa** (Hall). Oswayo formation; 2 miles west of Smethport, Pa., in a railroad cut along a spur line, nat size. P. 39.
3. **Reticularia præmatura** (Hall). Venango First Oil Sand horizon, near the Cobham monument, Pa. nat. size. P. 39.
4. **Idem.** From the very fossiliferous greenish sandstone on the west side of Robins Hill, near the top and just below a prominent conglomerate. nat. size.
5. **Spirifer disjunctus** Sowerby. From the original illustration of the species. Tr. Geol. Soc. of London, 28nd series, V, 1830, pl. 53, fig. 11. P. 27.
6. **Athyris angelica** Hall. Same faunule as Fig. 1. nat size. P. 35.

7-12. **Retzia** or **Rhynchospirina** sp. Venango First Oil sand horizon, at Stneoham, Pa. Slightly enlarged. P. 39.

13. **Rhynchospirina** sp. (Hall)?. From Pal. of N. Y., viii, ii, 1894, pl. 50, fig. 44.
14. **Rhynchospirina scansa** (Hall). From Pal. of N. Y., viii, ii, 1894, pl. 50, fig. 45.

15-17, 21. **Athyris polita** of Hall. From Pal. of N. Y., iv. 1867, pl. 47, figs. 27, 25, 23. P. 35.

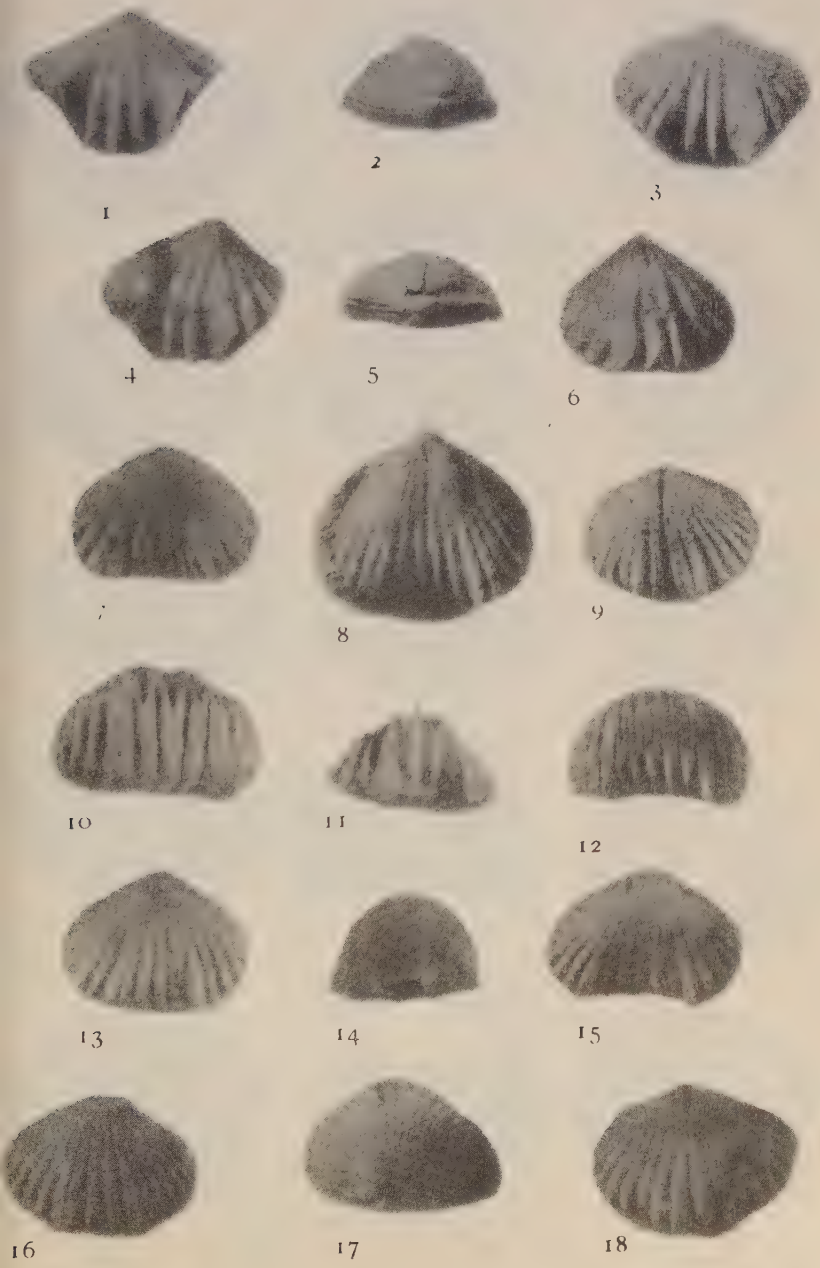
18. **Paraphorhynchus medialis** (Simpson). The illustration of the original description of the species. Tr. Am. Soc., n. h. 16, 1889, p. 444. P. 22.
19. **Athyris lamellosa** (L'eveille). From Pal. of N. Y., viii, ii, 1894, pl. 46, fig. 19. P. 36.
20. **Idem** fig. 18.

22-25. **Ambocœlia gregaria** (Hall). From Pal. of N. Y., iv, 1867, pl. 44, figs. 22, 19, 21, 20. P. 38.

EXPLANATION OF PLATE 12 (33)

FIGURE

1. **Camarotœchia contracta** Hall. Gowanda, N. Y. Width 18 mm. P. 10.
2. **Idem.** Width 17 mm.
3. **Camarotœchia sappho** (Hall). Base of the Conewango formation on Stone Hill, near Stoneham, Pa. Width 18 mm. P .
4. **C. contracta** (Hall). Ventral view of fig. 2.
5. **Idem.** Ventral view of fig. 2.
6. **Idem.** Dorsal view of fig. 2.
7. **C. sappho** (Hall). From the arcellus shale at LeRoy, N. Y. Shown for comparison with upper D ian specimens. Width 22 mm.
8. **C. sappho** (Hall?). From t e enango First Oil Sand one mile east of Stoneham, Pa. Width 23 m .
9. **Idem.** From Gowanda, N. Y. Width 20 mm.
10. **Idem.** From the top of th ango, one mile eas Stoneham, Pa. Width 23 mm.
11. **C. contracta** (Hall). Ant ew o
12. **C. sappho** (Hall). Anteri of
13. **Idem.** Dorsal view of fig. 7.
14. **Idem.** An unusually globular specimen from the base of the Conego on Stone Hill, near Stoneham, Pa. Length 16 mm.
15. **Idem.** Ventral view of fig. 10.
16. **Idem.** Dorsal view of fig. 10.
17. **Idem.** Cardinal view of fig. 10.
18. **Idem.** From the Conewango formation 2 miles north of Warren, Pa.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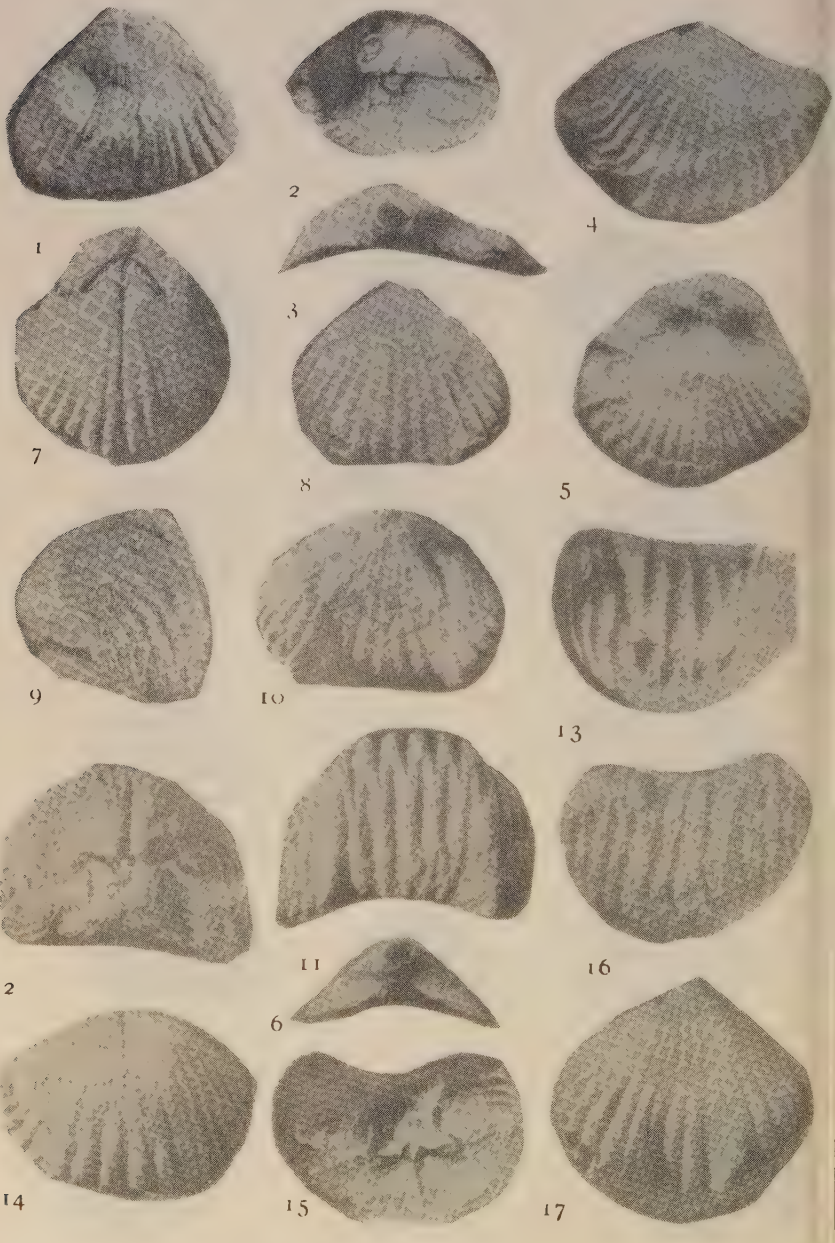
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EXPLANATION OF PLATE 13 (34)

FIGURE

1-6. **Rhynchospirina scansa** (Hall). From the chocolate shales 2 miles west of Smethport, Pa., in a cut along a spur railroad. x 9/7 approx. P. 39.

7. **Camarotoechia sappho** (Hall). From the Conewango 2 miles north of Warren, Pa. P. 15.

8. **Idem.** From a light brown quartzitic sandstone just west of Kinzua, Pa.

10. **Idem.** Ventral view of fig. 9.

11. Anterior view of fig. 9.

12. Cardinal view of fig. 9.

13. **Idem.** Conewango at Gowanda, N. Y., Width 21 mm.

14. **Idem.** Dorsal view of fig. 13.

15. Cardinal view of fig. 13.

16. **C. sappho** (Hall). From the same faunule as fig. 13. Width 24 mm.

17. Ventral view of fig. 16.

EXPLANATION OF PLATE 14 (35)

FIGURE

1. **Camarotœchia allegania** (Wms.). Dorsal view of an extra large specimen from the Oswayo beds as exposed along the Roosevelt highway one-half mile from Mt. Jewett on the road to Smethport. Length 21 mm. P. 13.
2. Ventral valve showing the large muscular platform and short dental lamellæ. The Oswayo beds, 2 miles west of Smethport, Pa., in a railroad cut. Width 21 mm.
3. **Camarotœchia** sp. From the Conewango at Stoneham, Pa. Width 12 mm.
4. **C. allegania** (Wms.). Oswayo, west of Kinzua, Pa. Height 20 mm.
5. Dorsal mold from the Oswayo sandstone on the road from Stickley to Bradford, Pa. Length 20 mm.
6. Oswayo. West of Kinzua, Pa. Height 18 mm.
7. Dorsal mold showing the impressions of the posterior crenulations and the well developed median septum. Oswayo at Kinzua, Pa. Width 16 mm.
8. Typical specimen from the Oswayo along the road from Stickley to Bradford, Pa. Length 17 mm.
9. Dorsal view of fig. 3.
10. **Camarotœchia** sp. Conewango at Stoneham, Pa. Width 9 mm.
11. Dorsal view of fig. 10.
12. **C. allegaina** (Wms.). Faunule of fig. 8. Length 21 mm.
13. **Idem.** Same faunule as fig. 4. Width 17 mm.
14. From the same faunule as fig. 8.
15. Same faunule as fig. 7. Width 21 mm.
16. **C. contracta** (Hall). From the Venango First Oil Sand horizon one mile east of Stoneham, Pa. Width 16 mm. P. 10.
17. **Idem.** Faunule of fig. 16. Width 16 mm.
18. Posterior view of fig. 17.
19. Ventral view of fig. 17.
20. Ventral view of fig. 16.
21. Anterior view of fig. 16.
22. **C. sappho?.** Same faunule as fig. 8. Length 18 mm.
23. **Camarotœchia contracta** (Hall). Faunule of fig. 16. Length 18 mm.
24. **Idem.** Width 13 mm.
25. **Idem.** Same faunule as fig. 24. Width 13 mm.
26. **Idem.** Faunule of fig. 16. Width 15 mm.
27. Ventral view of fig. 26.
28. **Idem.** Faunule of fig. 24. Width 14 mm.
29. Brachial valve of fig. 28.
30. Ventral view of fig. 23.

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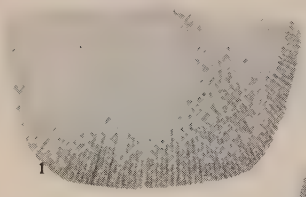
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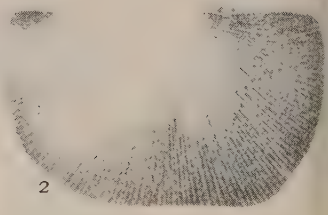
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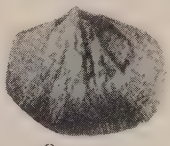
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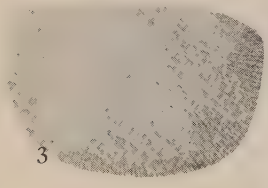
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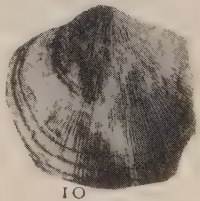
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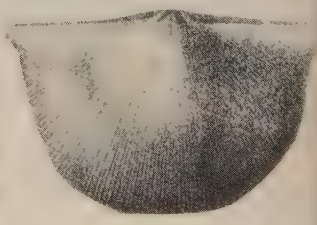

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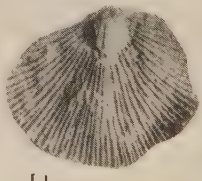
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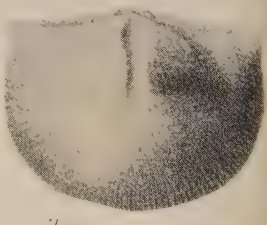
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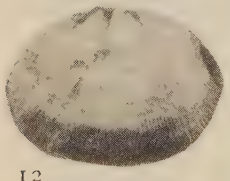
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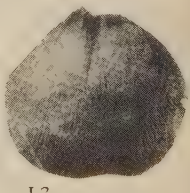
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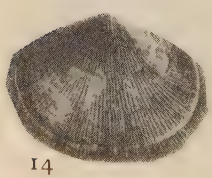
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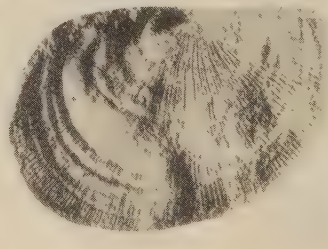
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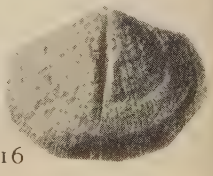
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EXPLANATION OF PLATE 15 (36)

FIGURE

1. **Schuchertella chemungensis** (Conrad). From Hall, Pal. of N. Y., iv, 1867, pl. 10, fig. 8. P. 6.
2. **Idem** fig. 11.
3. **Idem** fig. 7.
4. **Stropheodonta demissa** (Hall). From Pal. of N. Y., iv, 1867, pl. 19, fig. 10. P. 9.
5. **Schuchertella chemungensis** (Conrad). From Pal. of N. Y., iv, 1867, pl. 10, fig. 19.
6. **Idem** fig. 21.
7. **Stropheodonta demissa** (Hall). Ibid. pl. 19, fig. 11.
8. **Schuchertella chemungensis** (Conrad). Ibid. pl. 10, fig. 9.
9. **Rhipidomella** sp. The Venango First Oil sand horizon east of the Cobham monument. nat. size. P. 8.
10. **Schuchertella** cf. **chemungensis**. An external cast. ¾ mile east of Cobham, Pa. nat. size.
11. **Orothothetes** sp. Same horizon as fig. 9, in a creek bed one mile east of Stoneham, Pa. nat. size. P. 7.

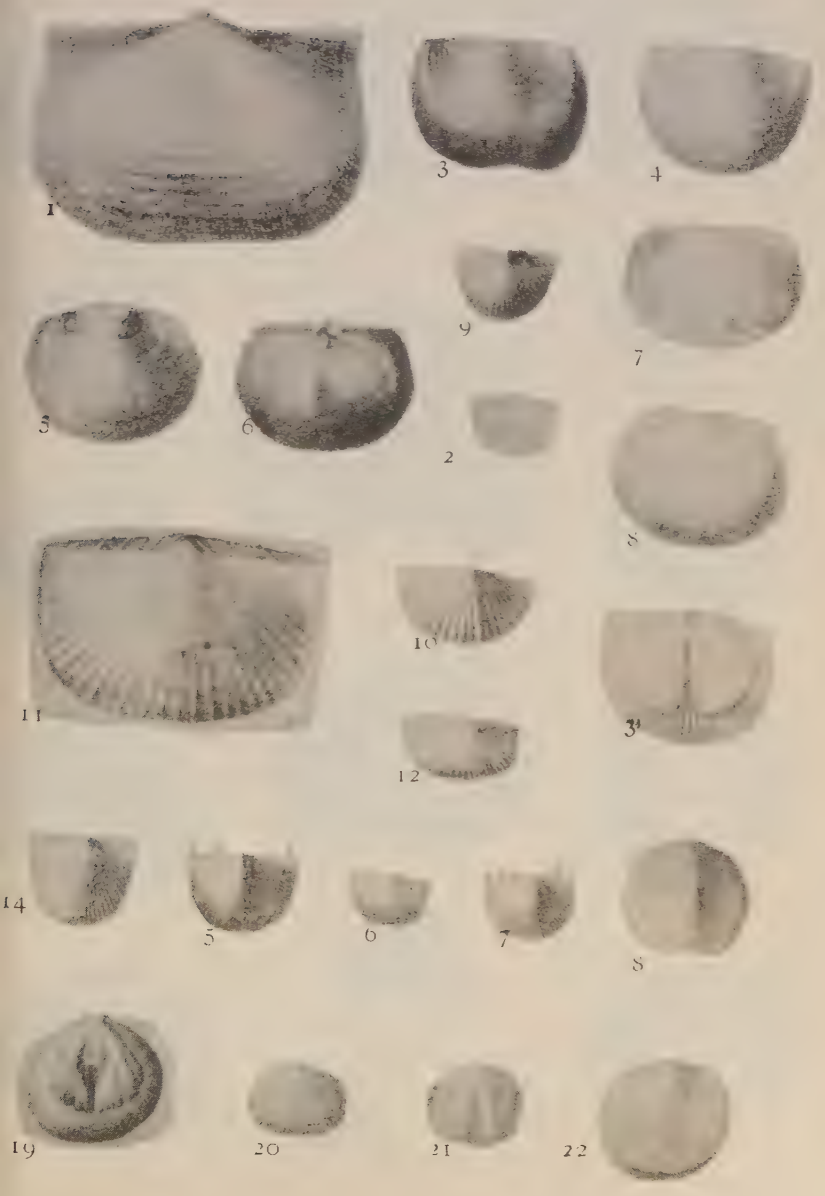
12, 13. **Schizophoria** sp. ?. Same faunule as fig. 9. nat. size. nat. size.

14. **Rhipidomella** af. **micheline** (Hall). From Conewango at Glade, Pa. P. 8.
15. **Schuchertella chemungensis.** Black Creek, Hudson twp., Allegany County, N. Y.
16. **Rhipidomella** sp. Same faunule as fig. 14. nat sinze.

EXPLANATION OF PLATE 16 (37)

FIGURE

1. **Orthothetes crenistria** (Phillips?). From Herrick, Bull. Dennison Univ. iv, 1888, pl. 4, fig. 1. P. 7.
2. **Idem.** fig. 5.
3. **Strophalosia muricata** (Hall). From Pal. of N. Y., iv, pl. 22, fig. 30. P. 7.
4. **Idem.** fig. 34.
5. **Idem.** fig. 35.
6. **Idem.** fig. 33.
7. **Idem.** fig. 29.
8. **Idem.** fig. 36.
9. **Chonetes scitulus** Hall. From Pal. of N. Y., iv, 1867, pl. 22, fig. 7. P. 7.
10. **Chonetes lepidus** Hall. From Pal. of N. Y., iv, 1867, pl. 22, fig. 13. P. 8.
11. **Chonetes scitulus** Hall. Ibid. fig. 10. P. 7.
12. **Idem.** fig. 6.
13. **Idem.** fig. 9.
14. **Chonetes setigerus** Hall. From Pal. of N. Y., iv, pl. 22, fig. 4. P. 8.
15. **Idem.** fig. 1.
16. **Ibdem.** fig. 2.
17. **Idem.** fig. 3.
18. **Dalamanella tenuilineata** (Hall). From Pal. of N. Y., iv, 1867, pl. 8, fig. 8 P. 8.
19. **Rhipidomella leucosia** (Hall). From Pal. of N. Y. iv, 1867, pl. 8, fig. 10. P. 8.
20. **Dalmanella tenuilineata** (Hall). Ibid. fig. 4.
21. **Idem.** fig. 3.
22. **Rhipidomella leucosia** (Hall). Ibid. fig. 9.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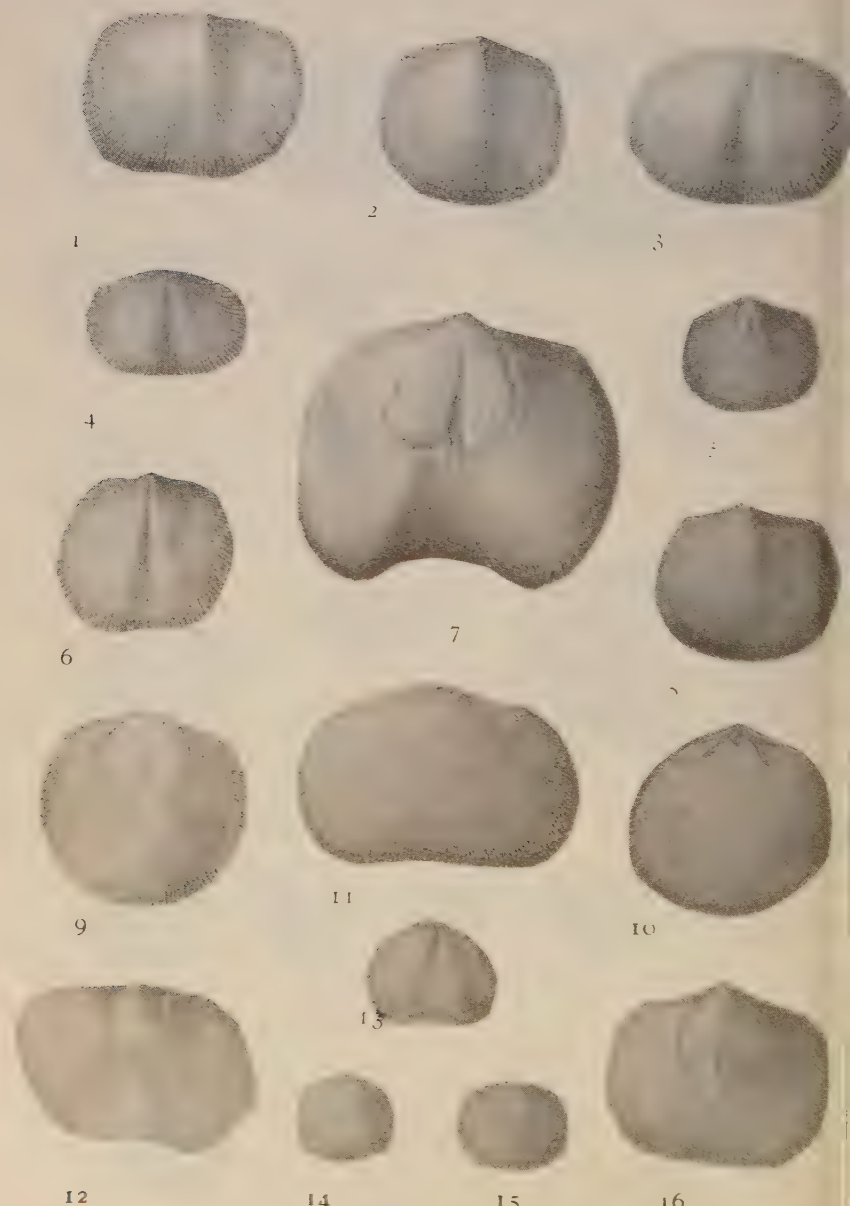
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EXPLANATION OF PLATE 17 (38)

FIGURE

1. **Schizophoria tioga** (Hall). From Pal. of N. Y., iv, 1867, pl. 8, fig. 27. P. 9.
2. **Idem**, fig. 26.
3. **Idem.** fig. 22.
4. **Idem.** fig. 20.
5. **Schizophoria striatula** (Hall). From Pal. of N. Y., iv, 1867, pl. 8, fig. 12. P. 9.
6. **Schizophoria tioga** (Hall). Ibid. fig. 21.
7. **Schizophoria striatula** (Hall). Ibid. fig. 19.
8. **Idem.** fig. 15.
9. **Rhipidomella pennsylvanica** (Simpson). Tr. Am. Phil. Soc., n. s. 16, 1889, p. 437. P. 8.
10. **Idem.**
11. **Schizophoria striatula** (Hall). Pal. of N. Y., iv, 1867, pl. 8, fig. 13.
12. **Schizophoria tioga** (Hall). Ibid. fig. 28.
13. **Dalmanella tenuilineata** (Hall). Ibid. fig. 5.
14. **Idem.** fig. 7.
15. **Schizophoria striatula** (Hall). Ibid. fig. 11.
16. **Idem.** fig. 16.

EXPLANATION OF PLATE 18 (39)

FIGURE

1-20. **Athyris angelica** Hall. P. 35.

1, 21. From the Venango First Oil sand horizon 1 mile east of Stoneham, Pa. nat. size.

3. From a yellow sandstone at Gowanda, N. Y. Width 19 mm.

4. From the faunule of fig. 1. Width 21 mm.

5. From the faunule of fig. 1. Width 18 mm.

6. Internal mold of fig. 1.

7. Same faunule as fig. 1. Width 26 mm.

8. Same faunule as fig. 1. Height 19 mm.

9. Dorsal mold from Gowanda, N. Y. Width 19 mm.

10. Ventral view of fig. 9.

11. From the faunule of fig. 1. Height 25 mm.

12. From the faunule of fig. 1. Length 19 mm.

13. Cardinal view of fig. 12.

14. From the faunule of fig. 1. nat. size.

15. Cardinal view of fig. 6.

16. The same horizon as fig. 1. Width 24 mm.

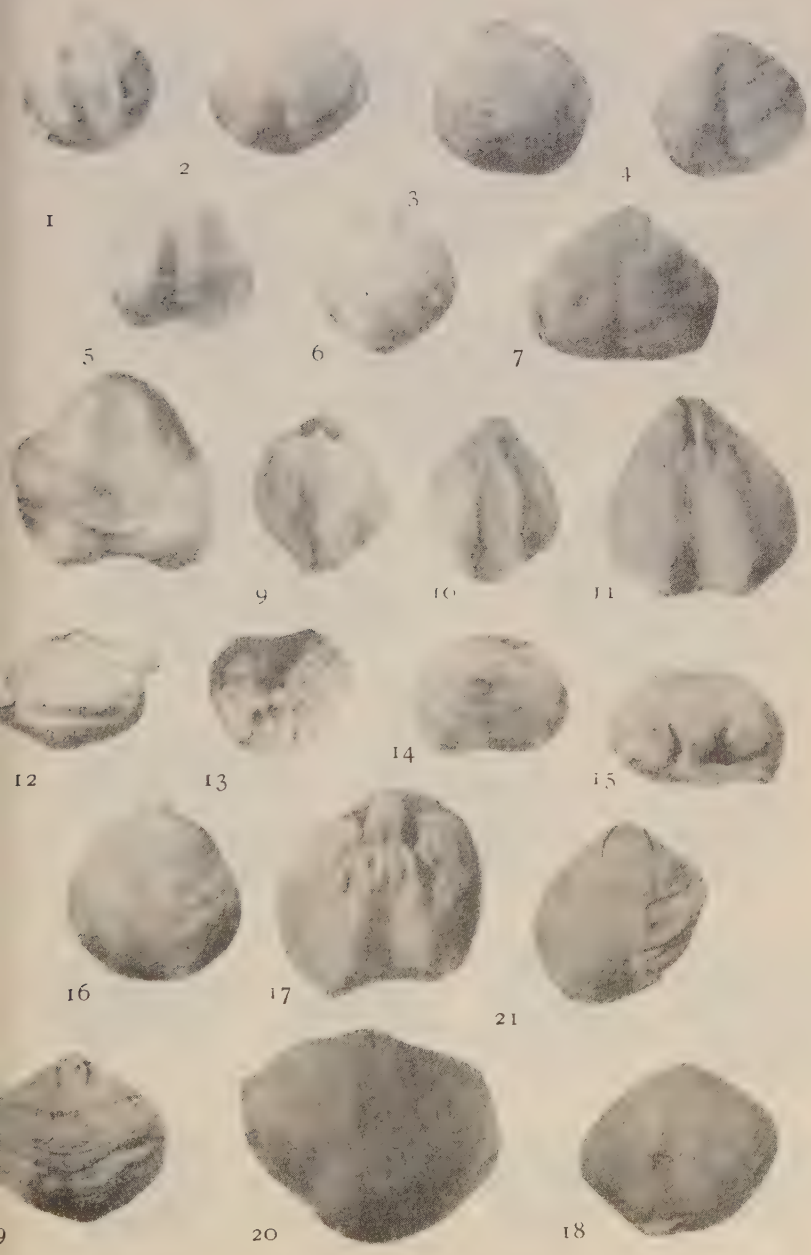
17. Same faunule as fig. 1. Width 21 mm.

18. From the faunule of fig. 3. Width 24 mm.

19. Same faunule as fig. 3. Width 19 mm.

20. Same faunule as fig. 3. Width 26 mm.

21. **Orthis** ? sp. From the Panama conglomerate at Panama Rocks, near Checkerboard School House. Length 21 mm.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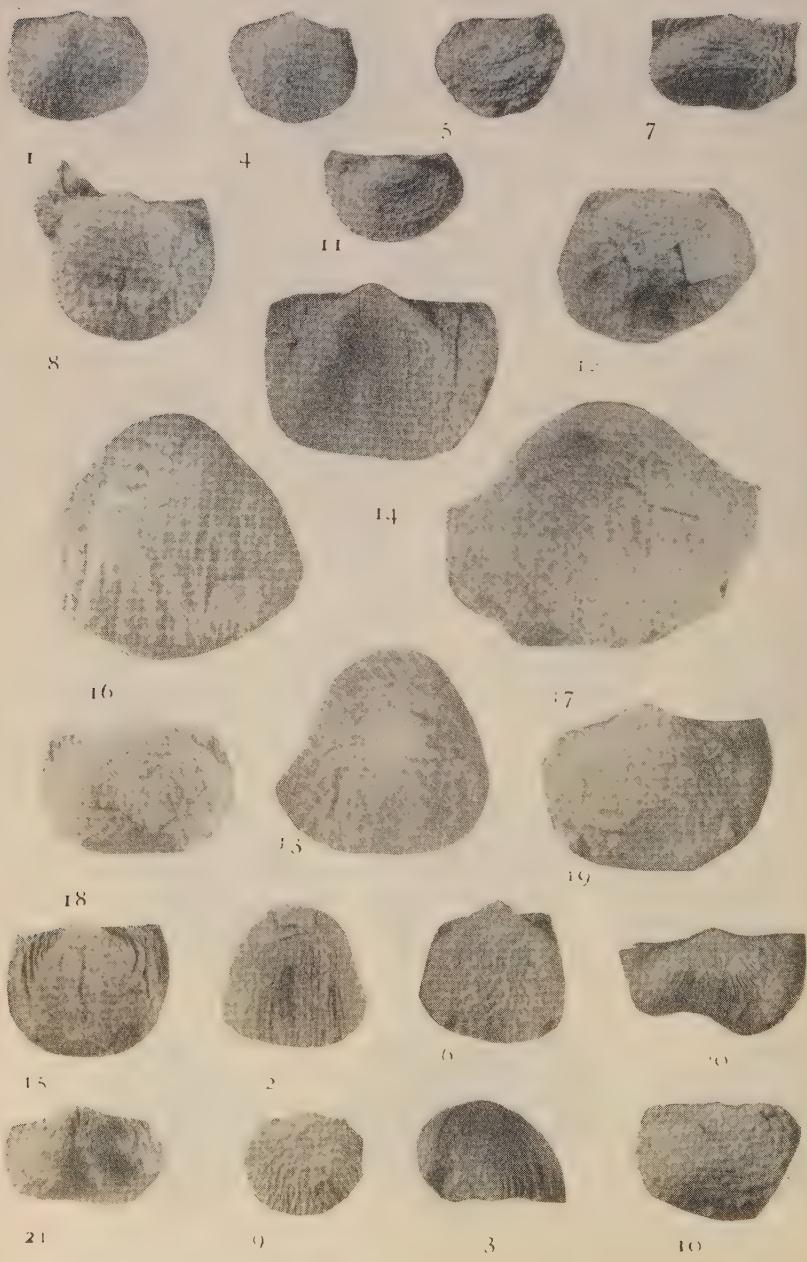
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EXPLANATION OF PLATE 19 (40)

FIGURE

1. **Productella costatula** Hall. 'Chemung beds' at East Randolph, N. Y. N. Y. S. Mus. spec. No. 8082-1. P. 26.
2. **P. costatula** Hall. Chemung beds in Chemung county, N. Y. N. Y. S. Mus. spec. no. 8082-3.
3. **Lateral view of fig. 1.**
4. **Productella speciosa** Hall. 'Chemung beds,' New Albion, N. Y. N. Y. S. Mus. spec. no. 8092-2. P. 26.
5. **P. speciosa** Hall. 'Chemung beds,' Leon, N. Y. N. Y. S. Mus. spec no. 8092-1.
6. **P. speciosa** Hall. 'Chemung beds,' Cattaraugus county, N. Y. N. Y. S. Mus. spec. no. 8092-3.
7. **Productella acutirostris** Hall. 'Chemung beds' at Leon, N. Y. N. Y. S. Mus. spec. no. 8080-1. P. 26.
8. **Productella lachrymosa** (Conrad). 'Chemung beds,' Randolph, N. Y. N. Y. S. Mus. spec. no. 8086-4. P. 25.
9. **P. lachrymosa** (Conrad). 'Chemung beds' at Ellington, N. Y. N. Y. S. Mus. spec. no. 8086-5.
10. **P. lachrymosa** (Conrad). Same locality as fig. 9. N. Y. S. spec. no. 8086-1.
11. **Productella hirsuta, var. rectispina.** 'Chemung beds' at Meadville,, Pa., N. Y. S. Mus. spec. no. 8085-1. P. 25.
12. **Productella lachrymosa, var. stigmata** Hall. 'Chemung beds' in Chautauqua county, N. Y. N. Y. S. Mus. spec. no. 8088-1. P. 25.
13. **P. l. var. stigmata** Hall. 'Chemung beds,' East Randolph, N. Y. N. Y. S. Mus. spec. no. 8088-3.
14. **Productella bialveata** Hall. 'Chemung beds.' at Meadville, Pa., N. Y. S. Mus. spec. no. 8081-4. P. 27.
15. **P. bialveata** Hall. Same faunule as fig. 14. N. Y. S. Mus. spec. no. 8081-1.
16. **Productus ?** sp. 'Chemung beds,' Cattaraugus county, N. Y. N. Y. S. Mus. spec. no. 8110-1.
17. **Productella onusta** Hall. 'Chemung beds' at Conewango, N. Y. N. Y. S. Mus. spec. no. 8090-5. P. 27.
18. **P. lachrymosa var. lima** Hall. 'Chemung beds' at Ellington, N. Y. N. Y. S. Mus. spec. no. 8072-2. P. 25.
19. **P. lachrymosa var. lima** Hall. 'Chemung beds' in Cattaraugus county, N. Y. N. Y. S. Mus. spec. no. 8087-1.
20. **B. lachrymosa var. lima.** On the slab with spec. no. 8087-3.
21. **P. lachrymosa var. lima** Hall. 'Chemung beds' at East Randolph, N. Y. N. Y. S. Mus. spec. no. 8087-3.

EXPLANATION OF PLATE 20 (41)

FIGURE

1. **Productella lachrymosa** var. **stigmata** Hall. 'Chemung beds' at Conewango, N. Y. N. Y. S. Mus. spec. no. 8088-4. P. 25.
2. **P. lachrymosa** var. **stigmata** Hall. 'Chemung beds' at East Randolph, N. Y. N. Y. S. Mus. spec. no. 8088-3 P 27
3. **Productella bialveate** Hall. 'Chemung beds' at Meadville, Pa. On a slab with the other types of **P. bialveata.**
4. **P. bialveata** Hall. On the slab with fig. 3. N. Y. S. Mus. spec. no. 8081-5.
5. **Productella onusta** Hall. 'Chemung beds' at New Albion, N. Y. N. Y. S. Mus. spec. no. 8090-2. P. 27.
6. **P. onusta** Hall. 'Chemung beds' at Conewango, N. Y. N. Y. S. Mus. spec. no. 8090-4.
7. **P. onusta** Hall. Same locality as fig. 5. N. Y. S. Mus. spec. no. 8090-1.
8. **P. onusta** Hall. From the Chemung beds at Gowanda, N. Y.
9. **P. onusta** Hall. Venango First Oil sand, one mile east of Stoneham, Pa.
10. **Productella costatula** Hall. 'Chemung beds' at East Randolph, N. Y. N. Y. S. Mus. spec. no. 8082-2. P. 26.
11. **P. costatula** ?. From the same faunule as fig. 9.
12. **P. costatula** ?. Anterior view of fig. 11.
13. **P. costatula.** Same faunule as fig. 9.
14. **P. lachrymosa** (Can). Same faunule as fig. 9.
15. **Strophalosia histricula** (Hall). 'Chemung beds,' Conewango, N. Y. N. Y. S. Mus. spec. no. 8390-6. P. 27.
16. **Idem.** 'Chemung beds' near East Randolph, N. Y. N. Y. S. Mus. spec. no. 8390-4.
17. **Idem.** 'Chemung beds' near Conewango, N. Y. N. Y. S. Mus. spec. no. 8390-2.
18. **Idem.** 'Chemung beds' near New Albion, N. Y. N. Y. S. Mus. spec. no. 8390-3.
19. **Idem.** 'Chemung beds,' Leon, Cattaraugus county, N. Y. N. Y. S. Mus. spec. no. 8390-1.
20. **Idem.** 'Chemung beds' at Leon, N. Y. N. Y. S. Mus. spec. no. 8390-5.

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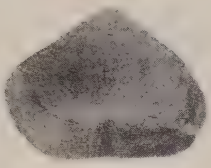
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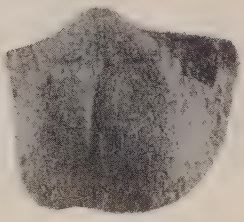
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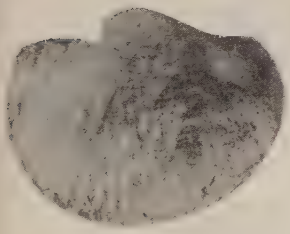
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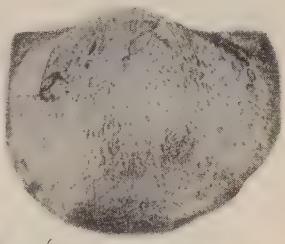
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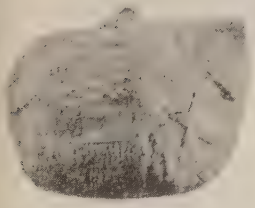
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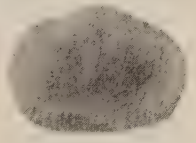
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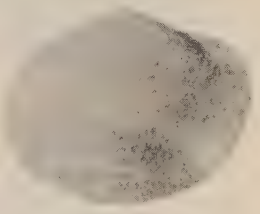
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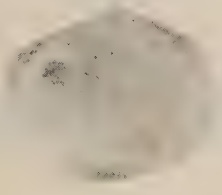
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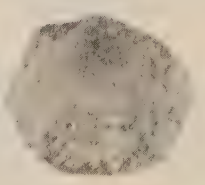
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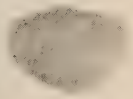
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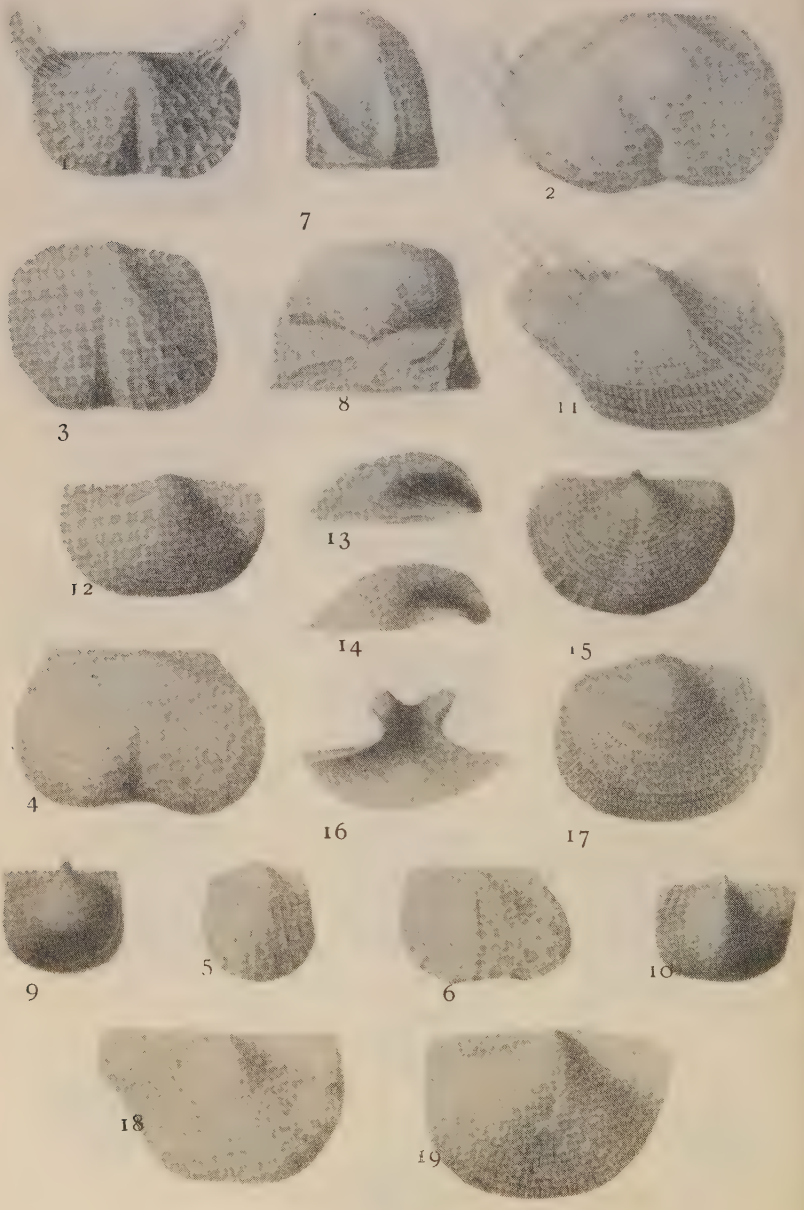
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EXPLANATION OF PLATE 20a (41a)

FIGURE

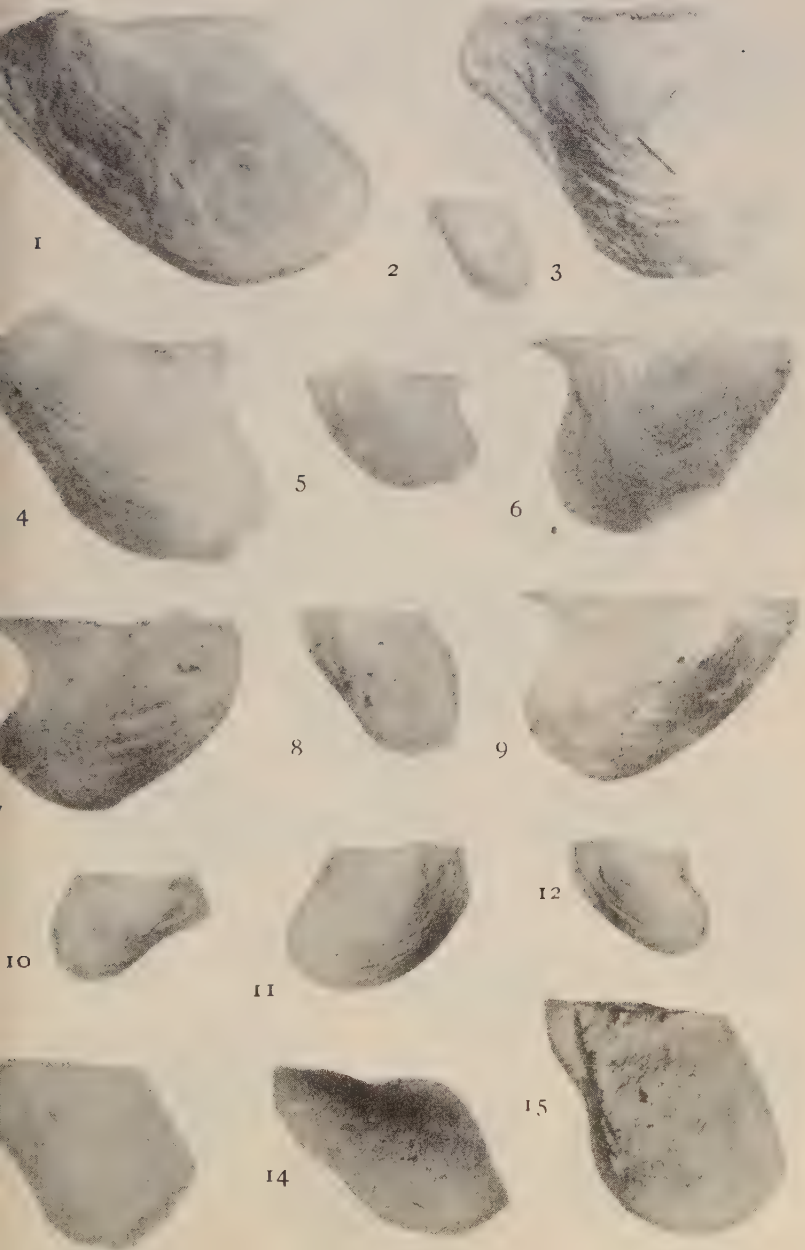
1. **Productella boydii** Hall. From the Pal. of N. Y., vol. iv, pl. 24, fig. 14.
2. **P. boydii.** Hall. Ibid. fig. 3.
3. **P. boydii.** Hall. Ibid. fig. 15.
4. **P. boydii** Hall. Ibid. fig. 12.
5. **P. boydii** Hall. Ibid. fig. 10.
6. **P. boydii** Hall. Ibid. fig. 11.
7. **Productella striatula** Hall. From Pal. of N. Y., iv, pl. 25, fig. 21. P. 27.
8. **P. striatula** Hall. Ibid. fig. 20.
9. **P. striatula** Hall. Ibid. fig. 14.
10. **P. striatula** Hall. Ibid. fig. 15.
11. **Productella hirsuta** Hall. From Pal. of N. Y., iv, pl. 24, fig. 26. P. 24.
12. **P. hirsuta** Hall. Ibid. fig. 18.
13. **P. hirsuta** Hall. Ibid. fig. 25.
14. **P. hirsuta** Hall. Ibid. fig. 23.
15. **P. hirsuta** Hall. Ibid. fig. 27.
16. **P. hirsuta** Hall. Ibid. fig. 22.
17. **P. hirsuta** Hall. Ibid. fig. 24.
18. **P. hirsuta** Hall. Ibid. fig. 20.
19. **P. hirsuta** Hall. Ibid. fig 19.

EXPLANATION OF PLATE 21 (42)

FIGURE

1. **Leptodesma potens** Hall. From the 'Chemung beds' at East Randolph, N. Y. N. Y. S. Mus. no. 9344-6. P. 45.
2. **Leptodesma mytiliforme** Hall. Upper 'Chemung beds' at Smethport, Pa. N. Y. S. Mus. no. 9338-1. P. 43.
3. **Leptodesma mentor** var. **rude** Hall. (**L. rude** Hall). From upper 'Chemung beds' at Smethport, Pa. N. Y. S. Mus. no. 9350-1. P. 51.
4. **Leptodesma potens** Hall. 'Upper Chemung beds' at Olean, N. Y. N. Y. S. Mus. no. 9344-4.
5. **Leptodesma potens, var. juvens** Hall. From the 'Chemung beds' at East Randolph, N. Y. N. Y. S. Mus. spec. no. 9345-1. P. 45.
6. **Leptodesma potens** Hall. Same locality as fig. 4. N. Y. S. Mus. spec. no. 9344-3.
7. **L. potens** Hall. Same locality as fig. 4. N. Y. S. Mus. spec. no. 9344-7.
8. **L. mentor** var. **orodes** Hall. (**L. orodes** Hall). In 'upper 'Chemung beds' on the road from Olean, N. Y., to Smethport, Pa. N. Y. S. Mus. spec. no. 9341-8. P. 50.
9. **Leptodesma potens** Hall. Same locality as fig. 1. N. Y. S. Mus. spec no. 9344-1.
10. **Leptodesma mentor** Hall. Same locality as fig. 3. N. Y. S. Mus. spec. no. 9336-1.
11. **Leptodesma matheri** Hall. Upper Chemung beds at Bradford, Pa. N. Y. S. Mus. spec. no. 9334-2.
12. **L. matheri** Hall. Same locality as fig. 11. N. Y. S. Mus. spec. no. 9334-3.
13. **L. mentor** var. **orodes** Hall. (**L. orodes** Hall). Same locality as fig. 8. N. Y. S. Mus. spec. no. 9341-2.
14. **L. mentor** Hall. Same locality as fig. 3. N. Y. S. Mus. spec. no. 9336-2.
15. **L. mentor** var. **orodes** Hall. (**L. orodes** Hall). Same locality as fig. 8. N. Y. S. Mus. spec. no. 9341-3.

All illustrations natural size.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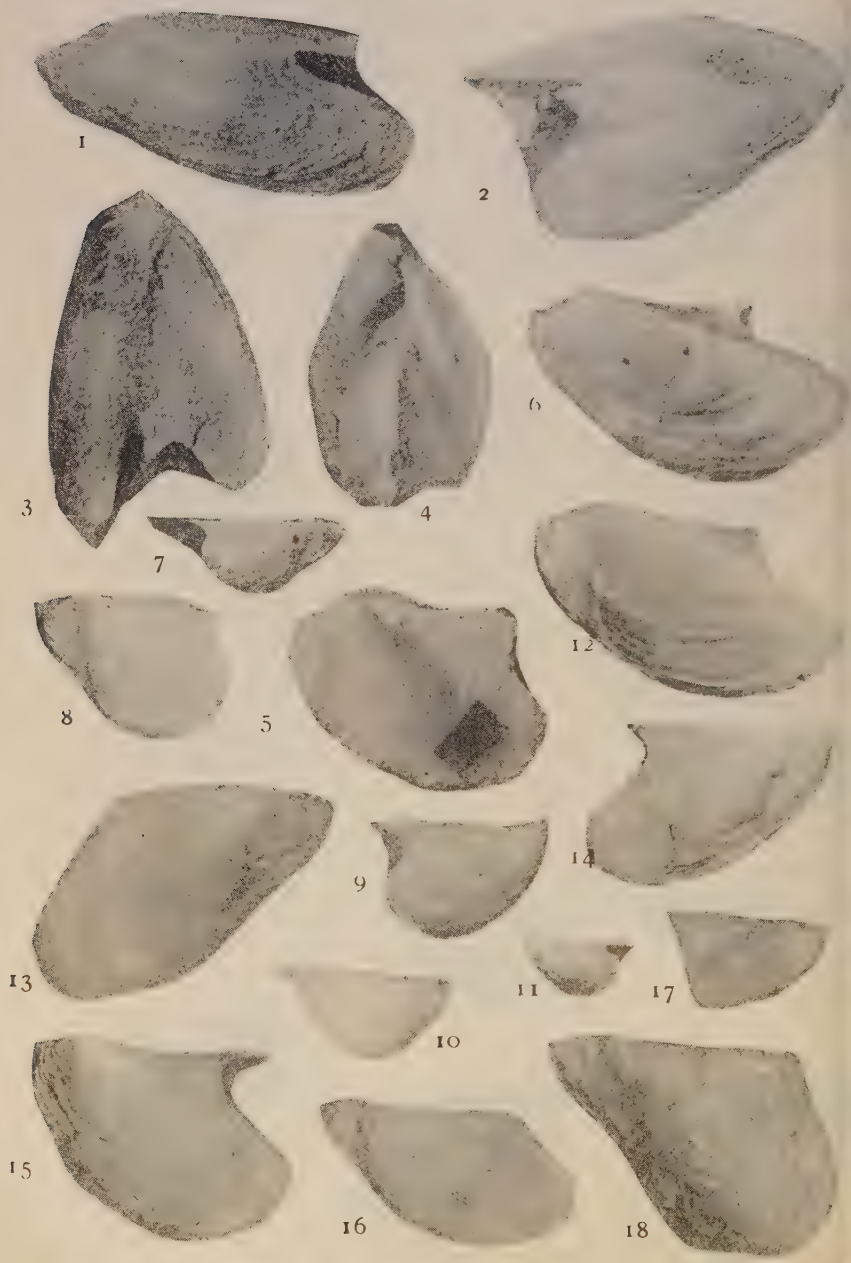
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EXPLANATION OF PLATE 22 (43)

FIGURE

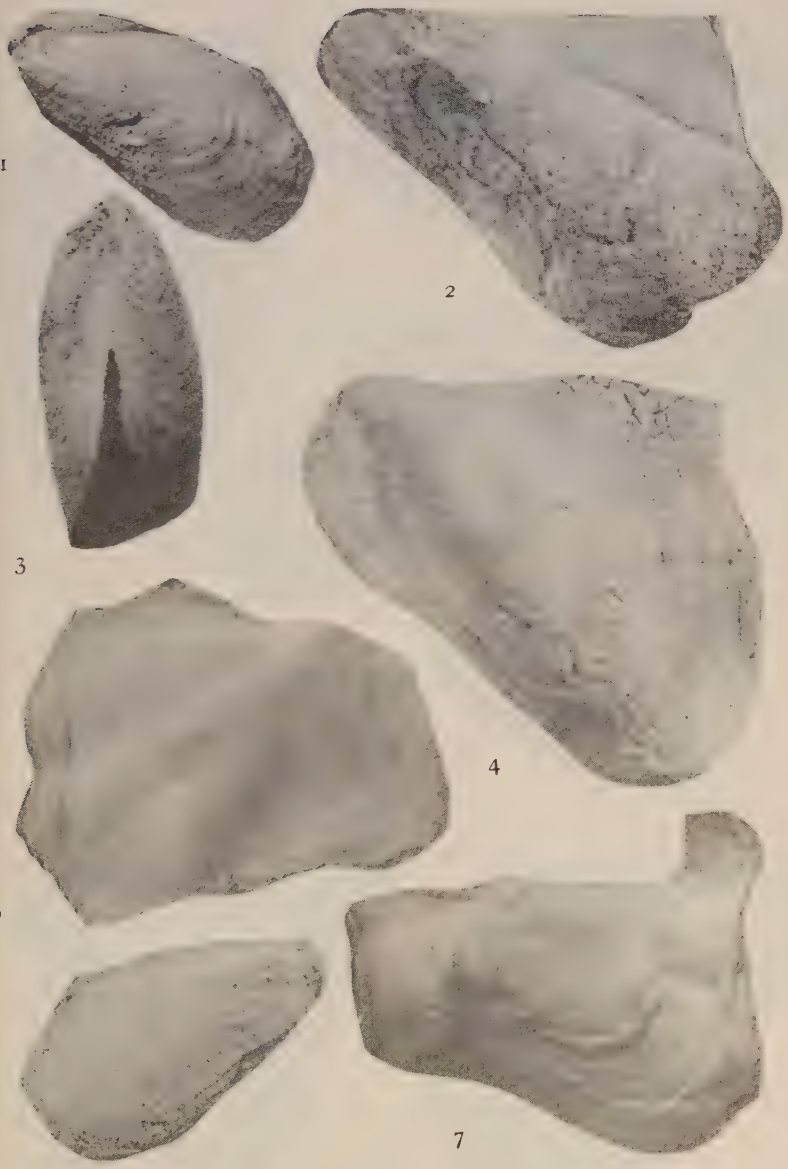
1. **Leptodesma mortoni** Hall. From the 'Chemung beds' at Little Genesee, N. Y. N. Y. S. Mus. spec. no 9337-4 P. 47.
2. Right valve of fig. 1.
3. Cardinal view of fig. 1.
4. **Leptodesma umbonatum** var. **depressum** Hall. Upper Chemung beds at Napoli Center, N. Y. N. Y. S. Mus. spec. no. 9356-1. P. 46.
5. Left valve of fig. 4.
6. **Leptodesma billingsi** Hall. From the 'Chemung beds' at Panama, N .Y. N. Y. S. Mus. spec. no. 9315-3. P. 47
7. **Leptodesma disparile** Hall. 'Upper Chemung beds' between Bradford, and Farmer's Valley, Pa. N. Y. S. Mus. spec. no. 9323-1.
8. **L. disparile** Hall. Same locality as fig. 7. N. Y. S. Mus. spec. no. 9323-3.
9. **L. disparile** Hall. Same locality as fig. 7. N. Y. S. Hus. spec .no. 9323-2.
10. **L. disparile** Hall. Same locality as fig. 7. N. Y. S. Mus. spec. no. 9323-4.
11. **L. disparile** Hall. Same locality as fig. 7. N. Y. S. Mus. spec. no. 9323-5.
12. **Leptodesma stephani** Hall. 'Upper Chemung beds' at Bradford, Pa. N Y. S. Mus. spec. no. 9354-3. P. 46.
13. **Leptodesma mentor** var. **maclurii** Hall. (**L. maclurii** Hall). From the 'Upper Chemung beds' at Smethport, Pa. N. Y. S. Mus. spec. No. 9333-1. P. 51.
14. **L. stephani** Hall. Same locality as fig. 12. N. Y. S. Mus. spec. no. 9354-1. P. 46.
15. **L. stephani** Hall. Same locality as fig. 12. N. Y. S. Mus. spec. no. 9354-2.
16. **Leptodesma curvatum** Hall. 'Upper Chemung beds' in McKean county, Pa. N. Y. S. Mus. spec. no. 9321-1. P. 47.
17. **Leptodesma becki** Hall ? . Chemung beds at Portville, N. Y. N. Y. S. Mus. spec. no. 9314-1. P. 45.
18. **Leptodesma mentor** var. **biton** Hall. (**L. biton** Hall). Upper Chemung beds south of Smethport, Pa. N. Y. S. Mus. spec. no. 9316-1. P. 50.

All illustrations natural size.

EXPLANATION OF PLATE 23 (44)

FIGURE

1. **Modiola** cf. **metella** or **præcedens** Hall. Panama Conglomerate at Stone Ledge near Checkered School House, N. Y. Length 30 mm. P. 72.
2. **Leptodesma mentor** var. **sulcata** n. var. From a fine white quartzitic sandstone under the Olean conglomerate at 'Devil's Den' south of Smethport, Pa. Cardinal-line 45 mm. P. 51.
3. Cardinal view of fig. 1.
4. **Leptodesma mentor** var. **maxima** n. var. Same faunule as fig. 2. Distance from apex to base 57 mm. (See also plate 24). P. 51.
5. **Prorhynchus pæneplanus** n. sp. In the yellow conglomerate sandstone 100 feet above the road at Glade, Pa. Posterior height 40 mm. P. 61.
6. Right valve of fig. 1.
7. **Prorhynchus harrisi** n. sp. From the coarse light brown sandstone under the conglomerate at Stickley, Pa. Sub-Olean (?). Width along cardinal-line 47 mm. P. 60.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EXPLANATION OF PLATE 24 (45)

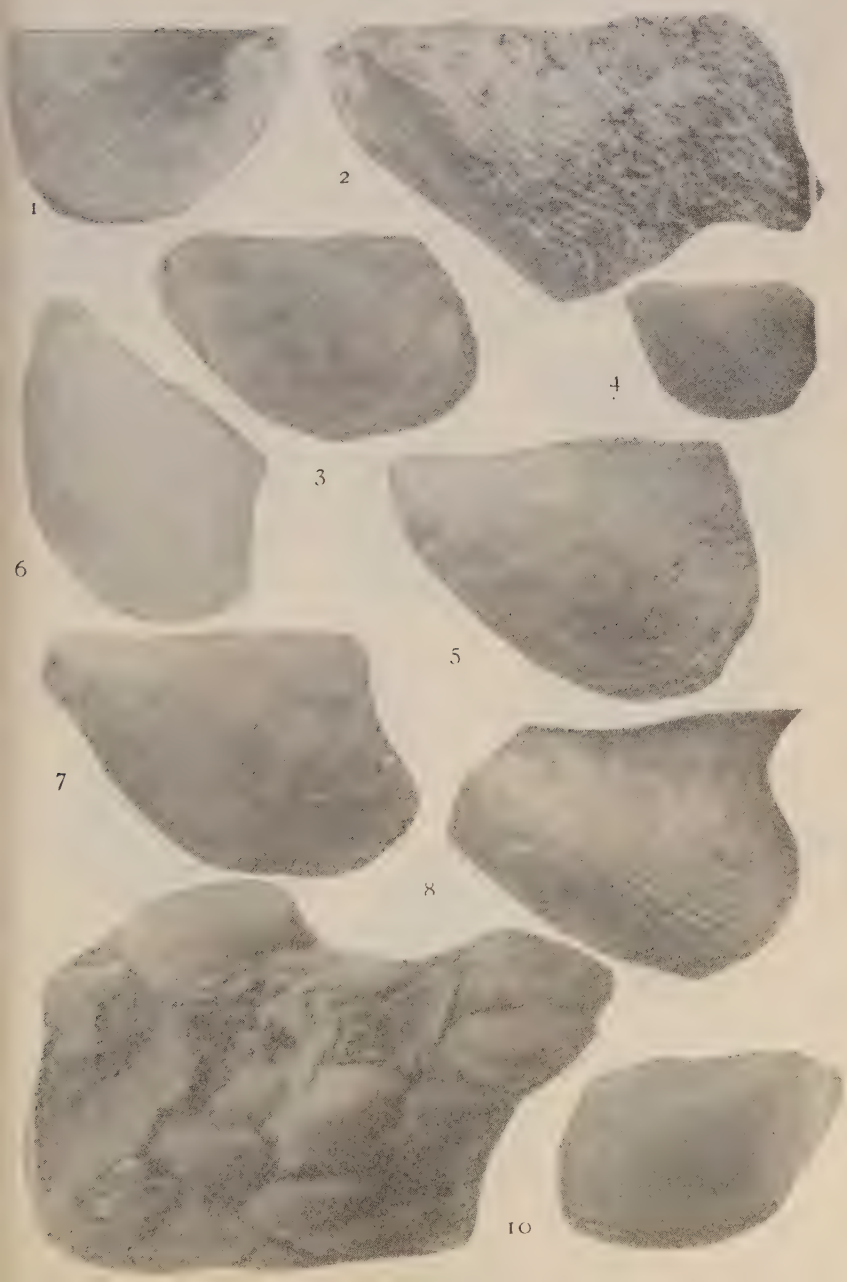
FIGURE

1. **Leptodesma mentor** var. **maxima n. var.** From the light gray sandstone under the Olean conglomerate at 'Devil's Den' south of Smethport, Pa. Hinge-line 32 mm. P. 53.
2. **Leptodesma mentor** var. **alpha** n. var. From the Oswayo beds in a road cut ½ mile from Mt. Jewett, Pa., on the road to Smethport, Pa. Hinge-line 30 mm. P. 53.
3. **Leptodesma carinifera** n. sp. Same faunule as fig. 2. Distance along the umbonal carina from the apex to the base 87 mm.
4. Right valve of fig. 1. P. 54.
5. **Leptodesma mentor** Hall. From a flat pebble conglomerate at Bradford, Pa. (Salamanca?). Hinge-line 12 mm. P. 49.
6. Left valve of fig. 1.
7. **Leptodesma mentor** var. **sulcata?** n. var. From the faunule of fig. 2. Hinge-line 47 mm. P. 51.

EXPLANATION OF PLATE 25 (46)

FIGURE

1. **Leiopteria cornelli** n. sp. From the horizon of the Venango First Oil sand on Stone Hill near Stoneham, Pa. Hinge-line 30 mm. P. 56.
2. **Oleanella expansa.** From the Oswayo sandstone at Flat Iron Station near Olean Rock City, N. Y. Hinge-line 34 mm. P. 63.
3. **Leiopteria cornelli,** n. sp. From the same faunule as fig. 1. Hinge-line 28 mm. P. 56.
4. **Actinopteria** ? sp. From the Panama conglomerate at Stone ledge near Checkered School House near Panama, N. Y. Hinge-line 20 mm. P. 65.
5. **Actinopteria alpha,** n. sp. 10 feet above the Roosevelt highway on the northern out-skirts of Smethport, Pa. In a local, coarse, brown, micaceous sandstone. Hinge-line 20 mm. P. 64.
6. **Actinopteria alpha,** n. sp. From the same faunule as fig. 5. Hinge-line 37 mm.
7. **Idem.** Hinge-line 36 mm.
8. **Actinopteria beta,** n. sp. From the same faunule as fig. 5. Hinge-line of fragment 21 mm. P. 65.
9. **Ptychopteria sao** Hall. From the Panama conglomerate at Panama, N. Y. nat. size. P. 70.
10. **Leiopteria cornelli,** n. sp. Right valve of fig. 3. P. 56.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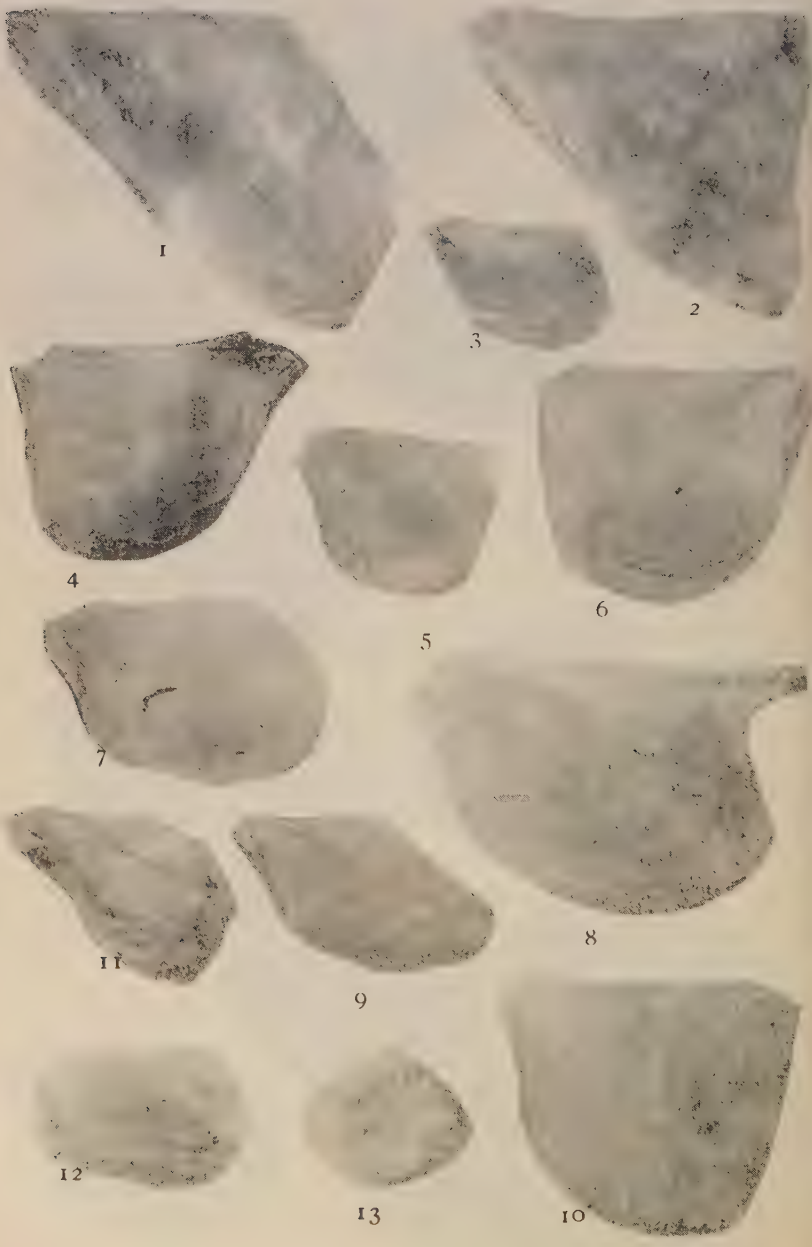
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EXPLANATION OF PLATE 25a (46a)

FIGURE

1, 2. **Leptodesma** cf. **mentor,** var. **sulcata**, n. var. Oswayo sandstone near Olean, N. Y. Nat. size. P. 51.

3-10. **Pegasella ales,** n. gen. n. sp. Same faunule as figs. 1 , 2. Nat. size.

11. Immature form of fig. 1. P. 57.

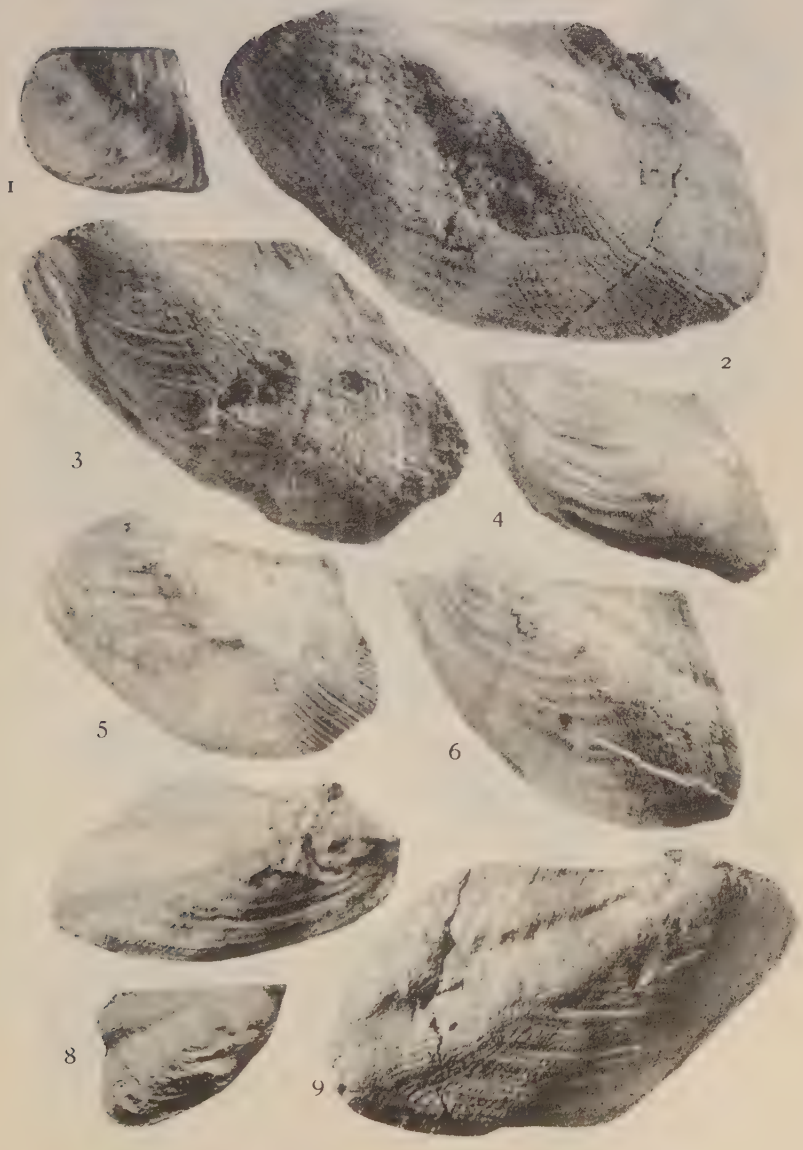
12. **Goniophora ruedemanni** n. sp. Same faunule as figs. 1-10. Nat. size P. 77.

13. Cross section of fig. 12.

EXPLANATION OF PLATE 26 (47)

FIGURE

1. **Ptychopteria** cf. **trigonalis** Hall. From the Conewango formation below the Pope Hollow Conglomerate at Pope Hollow, N. Y. x5/4. P. 67.
2. **Ptychopteria spatulata** or **beecheri** Hall. From the Conewango formation at Glade, Pa. x 3-2. P. 69.
3. **Ptychopteria elongata** Hall. From the Chemung group at Panama, N. Y. P. 69.
4. **Ptychopteria spatulata** or **beecheri** Hall. Same faunule as fig. 2. Nat. size. P. 69.
5. **Peychopteria spatulata** or **beecheri** Hall. Same faunule as fig. 2. x 3-2.
6. **Ptychopteria thetis** Hall ?. In the Conewango (?) 1mile west of Stoneham, Pa. x21-11. P. 70.
7. **Ptychopteria spatulata**, or **beecheri** Hall. Same faunule as fig. 2. x 13-11.
8. **Ptychopteria alata** Hall. From the faunule of fig. 1. x 5-4.
9. **Ptychopteria spatulata** or **beecheri** Hall. Faunule of fig. 2. x 14-9.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EXPLANATION OF PLATE 27 (48)

FIGURE

1-4. **Ptychopteria spatulata** or **beecheri** Hall. From the Conewango yellow standstone at Glade, Pa. approx. x 4-3.

5. **Ptychopteria elongata** Hall. The same faunule with fig. 1. x 17-6.

6. Left valve of fig. 5.

7. **Ptychopteria alata** Hall. From Conewango beds at Popes Hollow, N. Y. x 27-22.

8. **Ptychopteria alata** Hall. See fig. 7.

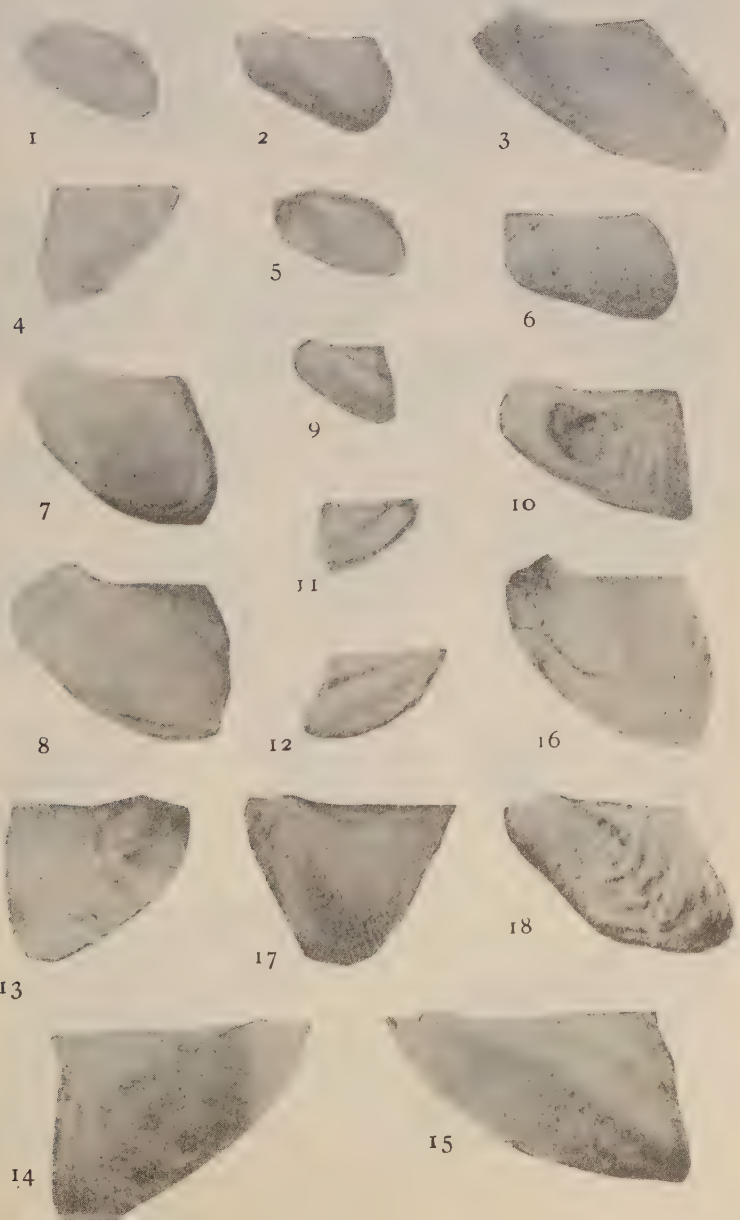
9. **Ptychopteria beecheri** Hall. From the yellow sandstone one mile east of Stoneham, Pa. x 5-2.

10. **Ptychopteria** cf. **trigonalis** Hall. Same faunule as fig. 7. x 33-18.

EXPLANATION OF PLATE 28 (49)

FIGURE

1. **Ptychopteria proto** Hall. From 'Chemung beds' at Smethport, Pa. N. Y. S. Mus. spec. no. 9805-1.
2. **Ptychopteria sinuosa** Hall. From 'Chemung beds' at Smethport, Pa. N. Y. S. Mus. spec. no. 9808-1.
3. **Ptychopteria eudora** Hall. 'Chemung ? beds' at Panama, N. Y. N. Y. S. Mus. spec. no. 9803-1.
4. **Ptychopteria thetis** Hall. Chemung ? beds at Panama, N. Y. N. Y. S. Mus. spec. no. 9810-4.
5. **Ptychopteria proto** Hall. 'Chemung beds' at Smethport, Pa. N. Y. S. Mus. spec. no. 9805-1.
6. **P. proto** Hall. Same locality as fig. 5. N. Y. S. Mus. spec. no. 9805-2.
7. **P. thetis** Hall. Same locality as fig. 4. N. Y. S. Mus. spec. no. 9810-3.
8. **P. thetis** Hall. Same locality as fig. 4. N. Y. S. Mus. spec. no. 9810-2.
9. **Ptychopteria trigonalis** Hall. Same locality as fig. 5. N. Y. S. Mus. spec. no. 9811-1. P. 67.
10. **P. trigonalis** Hall. Same locality as fig. 4. N. Y. S. Mus. spec. no. 9811-2.
11. **Ptychopteria alata** Hall. 'Chemung beds?' at Salamanca, N. Y. N. Y. S. Mus. spec. no. 9800-1. P. 68.
12. **P. alata** Hall. Same locality as fig. 11. N. Y. S. Mus. spec. no. 9800-2.
13. **P. alata** Hall. Same locality as fig. 11. N. Y. Mus. spec. no. 9800-3.
14. **P. alata** Hall. Same locality as fig. 11. N. Y. S. Mus. spec. no. 9800-4.
15. **P. alata** Hall. Same locality as fig. 11. N. Y. S. Mus. Spec. no. 9800-5.
16. **P. thetis** Hall. Same locality as fig. 4. N. Y. S. Mus. spec. no. 9810-1.
17. **Oleanella expansa** (Hall). N. G. (**Ptychopteria expansa** Hall). Same locality as fig. 5. N. Y. S. Mus. spec. no. 9805-1. P. 63.
18. **Ptychopteria spio** Hall. Same locality as fig. 4. N. Y. S. Mus. spec. no. 9809-1. P. 70.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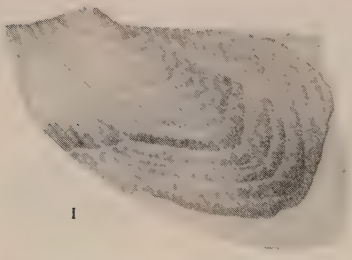
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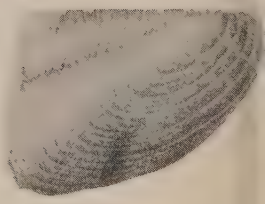
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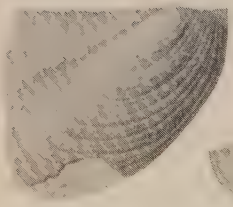
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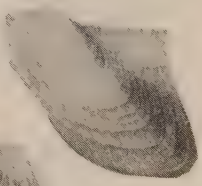
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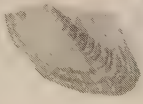
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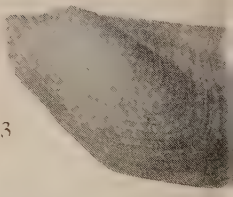
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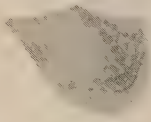
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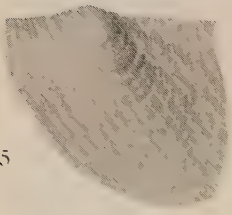
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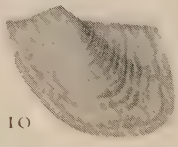
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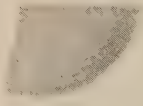
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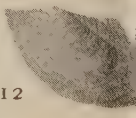
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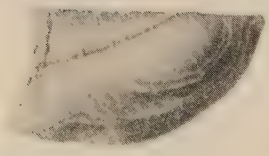
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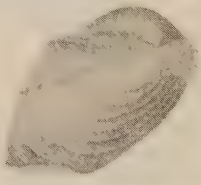
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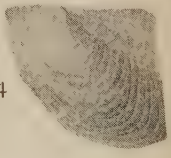
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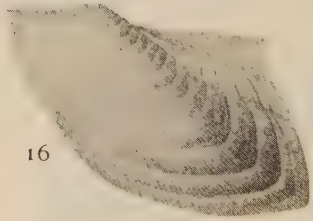
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EXPLANATION OF PLATE 29 (50)

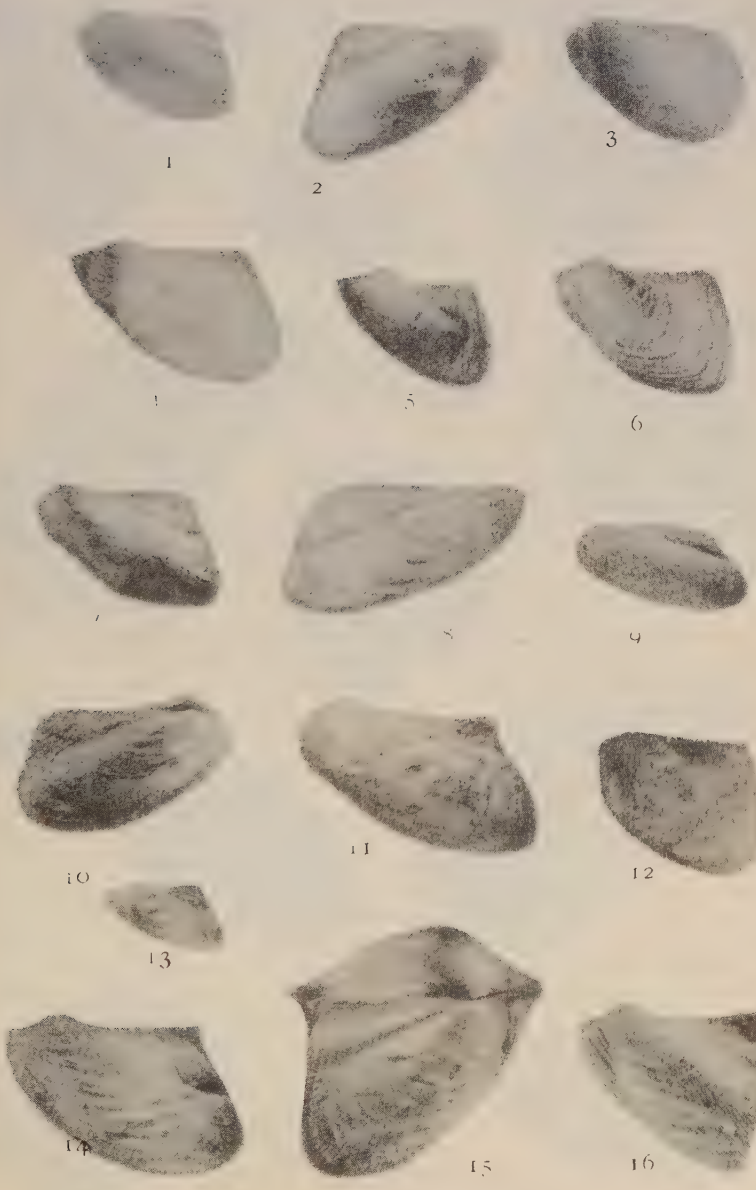
FIGURE

1. **Ptychopteria spatulata** Hall. From Pal. of N. Y., v, i, pl. 85, fig. 20. P. 69.
2. **Ptychopteria lata** Hall. Ibid. fig. 25.
3. **Ptychopteria lata** Hall. Ibid. fig. 23.
4. **Ptychopteria periata** Hall. Ibid. fig. 38. P. 68.
5. **Ptychopteria perlata** Hall. Ibid. fig. 39.
6. **Ptychopteria falcata** Hall. Ibid. fig. 6. P. 68.
7. **Ptychopteria falcata** Hall. Ibid. fig. 7.
8. **Ptychopteria gibbosa** Hall. Ibid. fig. 5. P. 67.
9. **Ptychopteria lobata** Hall. Ibid. fig. 37. P. 67.
10. **Ptychopteria thalia** Hall. Ibid. fig. 33. P. 68.
11. **Ptychopteria thalia** Hall. Ibid. fig. 32.
12. **Ptychopteria galene** Hall. Ibid. fig. 30. P. 68.
13. **Ptychopteria galene** Hall. Ibid. fig. 31.
14. **Ptychopteria galene** Hall. Ibid. fig. 39.
15. **Ptychopteria beecheri** Hall. Ibid. fig. 22. P. 69.
16. **Ptychopteria beecheri** Hall. Ibid. fig. 21.
17. **Ptychopteria vanuxemi** Hall. Ibid. fig. 36. P. 67.

EXPLANATION OF PLATE 30 (51)

FIGURE

1. **Ptychopteria sao** Hall. From the 'Chemung'? beds at Panama, N. Y., N. Y. Mus., spec. no. 9807-6. P. 70.
2. **P. sao** Hall. Same locality as fig. 1. N. Y. mus., spec. no. 9807-1.
3. **P. sao** Hall. Same locality as fig. 1. N. Y S. Mus., spec. no. 9807-7.
4. **P. sao** Hall. Same locality as fig. 1. N. Y. S. Mus., spec. no. 9807-5.
5. **P. sao** Hall. Same locality as fig. 1. N. Y. S. Mus., spec. no. 9807-3.
6. **P. sao** Hall. Same locality as fig. 1. N. Y. S. Mus., spec. no. 9807-2.
7. **Ptychopteria elongata** Hall. From the same locality as fig. 1. N. Y. S. Mus., spec. no. 9801-1. P. 69.
8. **P. elongata** Hall. Same locality as fig. 1. N. Y. S. Mus., spec. no. 9801-3.
9. **P. elongata** Hall. Same locality as fig. 1. N. Y. S. Mus, spec. no. 9801-2.
10. **Ptychopteria eucrate** Hall. Same locality as fig. 1. N. Y. S. Mus., spec. no. 9802-1. P. 69.
11. **P. eucrate** Hall. From the same locality as fig. 1. N. Y. S. Mus., spec. no. 9802-3.
12. **P. eucrate** Hall. On slab of rock with type specimen no. 9802-3.
13. **P. eucrate** Hall. Same locality as fig. 1. N. Y. S. Mus., spec. no. 9802-2.
14. **Ptychopteria salamanca** Hall. From 'Chemung beds' at rock city near Salamanca, N. Y. N. Y. S. Mus., spec. no. 9806-2. P. 67.
15. **P. salamanca** Hall. Same locality as fig. 14. N. Y. S. Mus., spec. no. 9806-3.
16. **P. salamanca** Hall. Same locality as fig. 14. N. Y. S. Mus., spec. no. 9806-1.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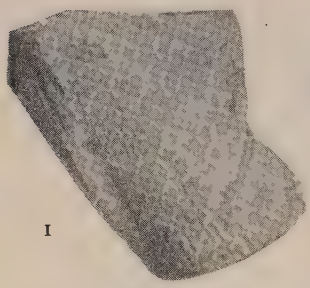
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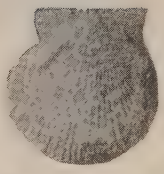
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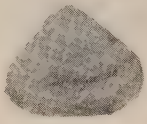
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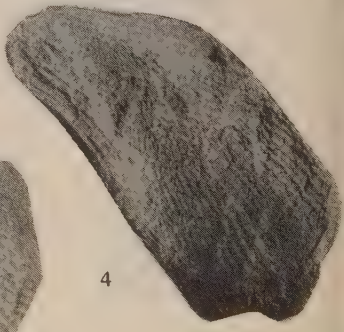
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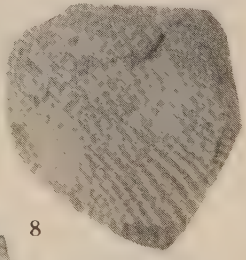
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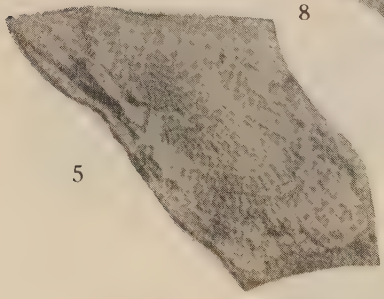
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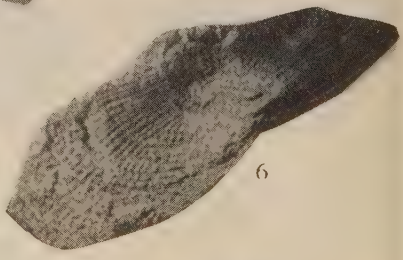
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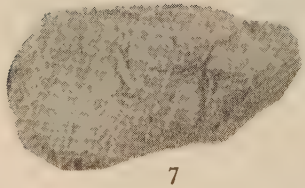
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EXPLANATION OF PLATE 30a (51a)

FIGURE

1-7. **Oleanella expansa** (Hall), n. gen. Oswayo sandstone near Olean, N. Y. Nat. size. P. 69.

8. **Oleanella expansa,** var. **gamma** n. var. Same faunule as figs. 1-7. Nat-size. P. 69.

9. **Aviculipecten** sp. Same faunule as fig. 9. Nat. size.

10. **Aviculipecten** sp. Same faunule as fig. 9 nat. size.

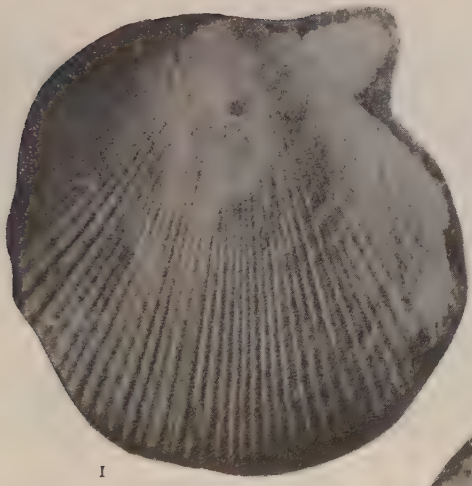
11. **Nucula sp.** Same faunule as figs. 1-10. x 2.

12. **Pararca** sp. undet. Nat. size.

EXPLANATION OF PLATE 31 (52)

FIGURE

1. **Aviculipecten æquilateralis** Hall. Conewanga beds 2 miles northwest of Warren, Pa. Height 53 mm. P. 41.
2. **Aviculipecten** cf. **striatus** (Hall). From the brown quartzitic sandstone below the conglomerate at Stickley, Pa. Height 17 mm. P. 40.
3. **A. cf. striatus** (Hall). From the faunule of fig. 2. Height 21 mm.
4. **A. cf. striatus** (Hall). From the figure of fig. 1. Height 25 mm.
5. **A. cf. striatus** (Hall). From the faunule of fig. 1. Height 24 mm.
6. **Aviculipecten** sp. An external cast. Conewanga formation near Bradford, Pa. Height 38 mm.



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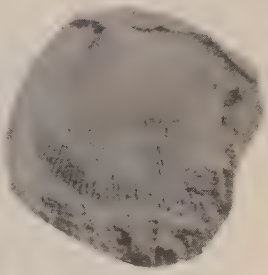

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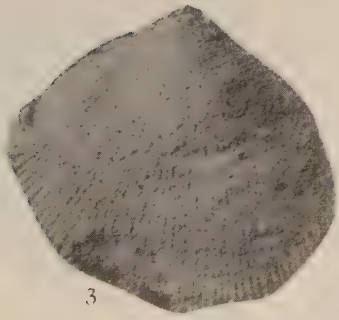

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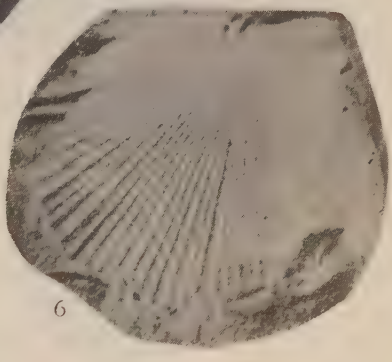

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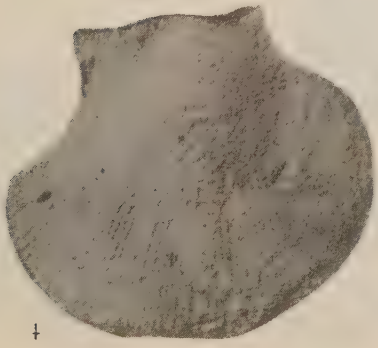

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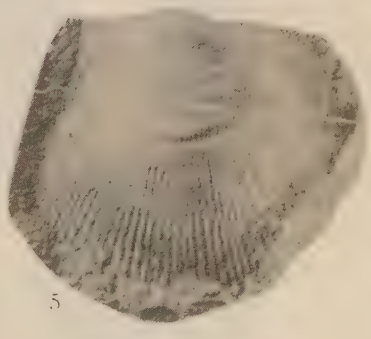

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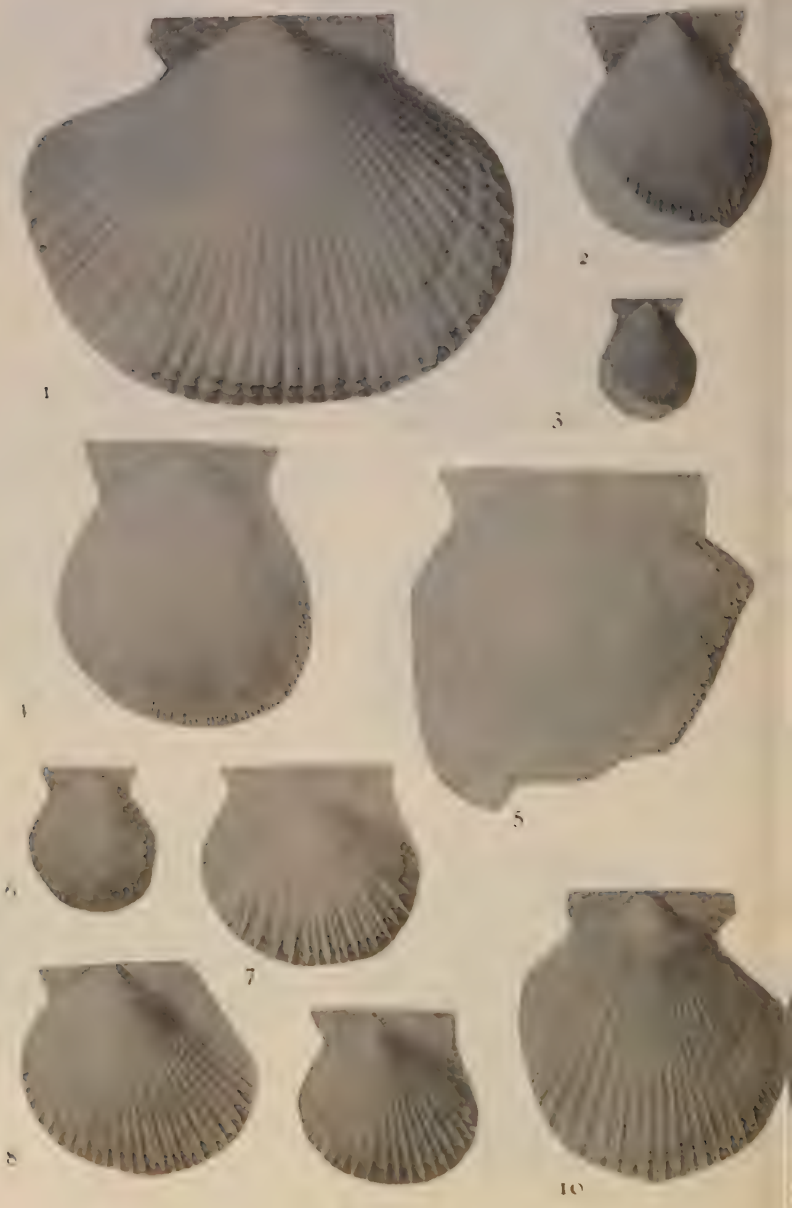
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EXPLANATION OF PLATE 32 (53)

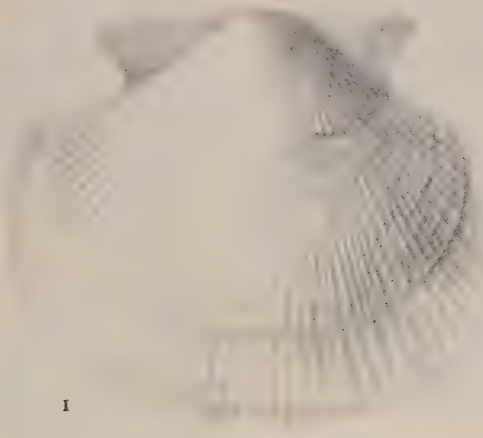
FIGURE

1. **Aviculipecten ellipticus** Hall. From Pal. of N. Y., v, i, pl. 7, fig. 31. P. 40.
2. **Aviculipecten celsus** Hall. Ibid. fig. 30. P. 40.
3. **A. celsus** Hall. Ibid. fig. 29.
4. **Aviculipecten striata** Hall. Pal. of N. Y., v, i, pl. 10, fig. 4. P. 40.
5. **Aviculipecten æquilata** Simpson. From Tr. Am. Phil. Soc., n. s. 16, 1889, p. 445. P. 41.
6. **A. striata** Hall. Pal. of N. Y., v, i, pl. 10, fig. 3.
7. **Aviculipecten tenuis** Hall. Pal. of N. Y., v, i, pl. 81, fig. 6. P. 40.
8. **A. tenuis** Hall. Ibid., pl. 7, fig. 28.
9. **A. tenuis** Hall. Ibid. fig. 27.
10. **Aviculipecten æquilateralis** Hall. Ibid. pl. 82, fig. 1. P. 41.

EXPLANATION OF PLATE 33 (54)

FIGURE

1. **Aviculipecten patulus** Hall. From Pal. of N. Y., pl. 7, fig. 33. P. 41.
2. **A. patulus** Hall. **Ibid,** fig. 32.
3. **Aviculipecten cancellatus** Hall. **Ibid,** fig. 17. P. 41.
4. **A. cancellatus** Hall. **Ibid.** fig. 12.
5. **A. cancellatus** Hall. **Ibid.** fig. 15. 15.
6. **Aviculipecten duplicatus** Hall. **Ibid.,** fig. 3. P. 40.
7. **A. duplicatus** Hall. **Ibid.,** fig. 7.
8. **A duplicatus** Hall. **Ibid.,** fig. 2.
9. **A duplicatus** Hall. **Ibid.,** fig. 6.
10. **A. duplicatus** Hall. **Ibid.** fig. 4.
11. **Lyriopecten solox** Hall. **Ibid.,** pl. 24, fig. 5. P. 41.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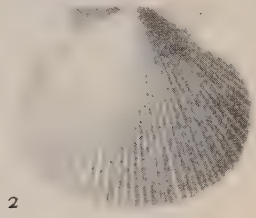
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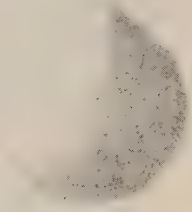
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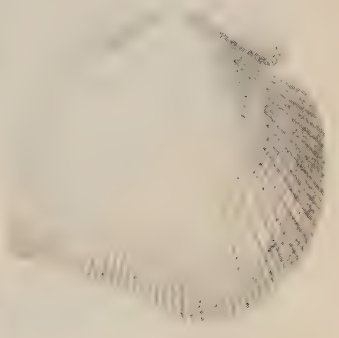
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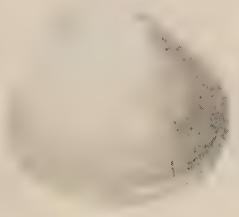
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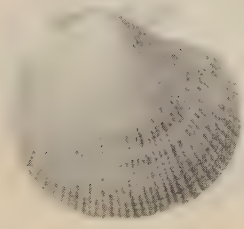
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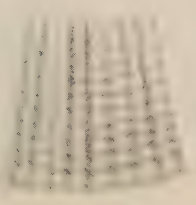
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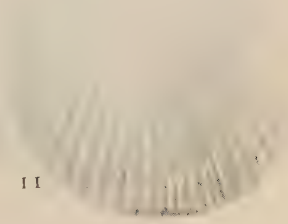
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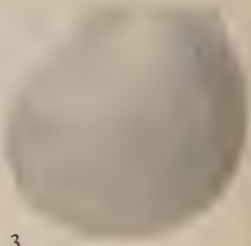

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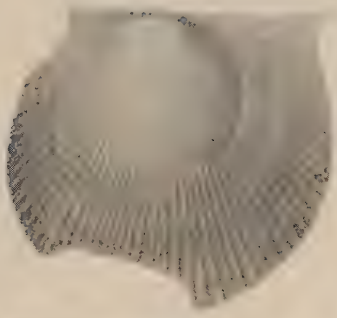

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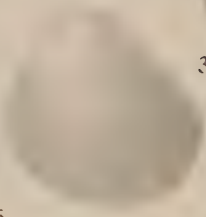

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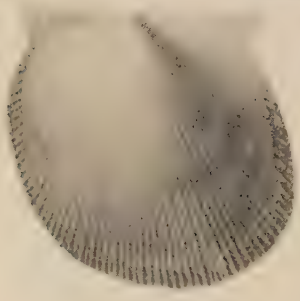

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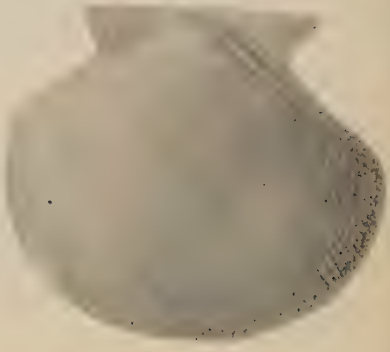

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EXPLANATION OF PLATE 34 (55)

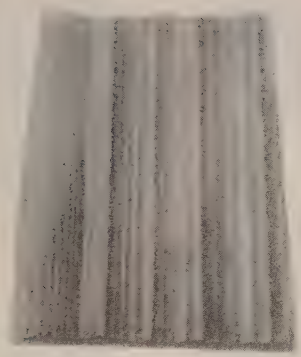
FIGURE

1. **Pterinopecten suborbicularis** Hall. From Pal. of N. Y., v, i, pl. 24, fig. 10. P. 41.
2. **P. suborbicularis** Hall. **Ibid.**, pl. 82, fig. 4.
3. **Crenipecten crenulatus** Hall. **Ibid.** pl. 9, fig. 6. P. 42.
4. **Pterinopecten suborbicularis** Hall. **Ibid.** pl. 8, fig. 2.
5. **Crenipecten impolitus** Hall. **Ibid.** pl. 9, fig. 14. P. 42.
6. **Crenipecten micropterus** Hall. **Ibid.** fig. 23. P. 42.
7. **Crenipecten simplus** Hall. **Ibid.** fig. 9. P. 42.
8. **Crenipecten crenulatus** Hall. **Ibid.** fig. 17.
9. **Pterinopecten suborbicularis** Hall. **Ibid.** pl. 8, fig. 1. P. 41.
10. **Crenipecten winchelli** Hall. **Ibid.** pl. 9, fig. 27. P. 42.

EXPLANATION OF PLATE 35 (56)

FIGURE

1. **Lyriopecten fasciata** Hall. From Pal. of N. Y., v, i, pl. 9, fig. 11. P. 41.
2. **Lyriopecten priamus** Hall. **Ibid.** pl. 82, fig. 6. P. 41.
3. **Lyriopecten fasciata** Hall. **Ibid.**, pl. 9, fig. 10. P. 41.
4. **Crenipecten leon** Hall. **Ibid.**, fig. 12. P. 42.
5. **C. leon** Hall. **Ibid.** pl. 83, fig. 8.
6. **Lyriopecten alternatus** Simpson. Tr. Am. Phil. Soc. n. s. 16, 1889, p. 446. P. 41.
7. **Crenipecten liratus** Hall. Pal. of N. Y., v, i, pl. 9, fig. 24. P. 42.
8. **C. liratus** Hall. **Ibid.**, pl. 83, fig. 9.



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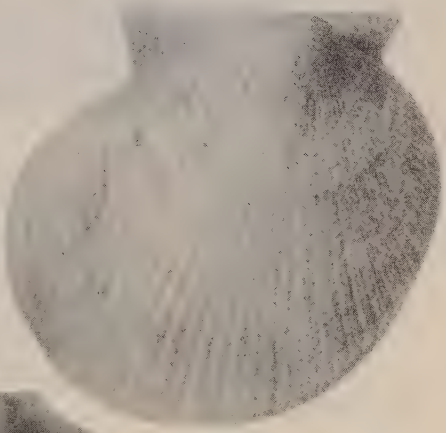

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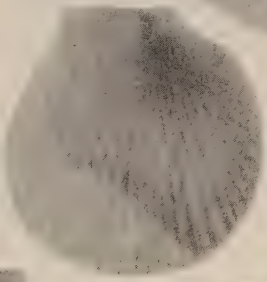

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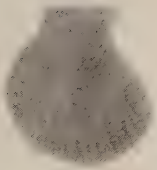

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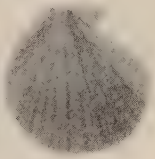

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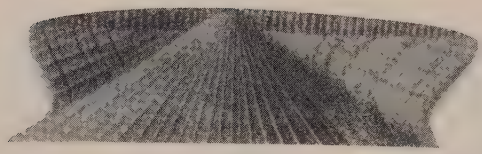

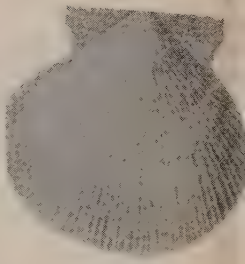

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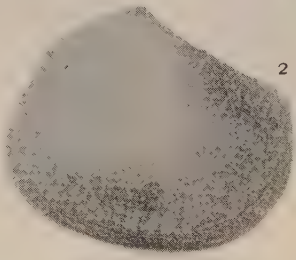

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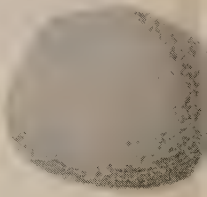

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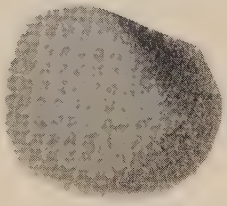

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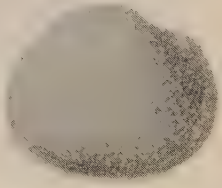

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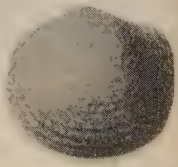

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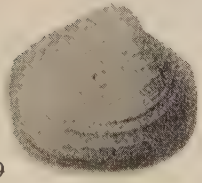

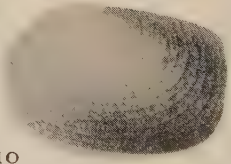

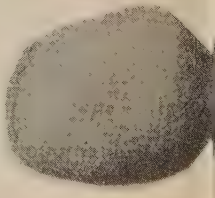

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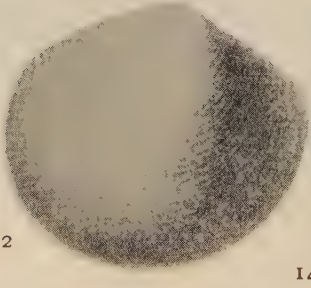

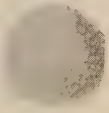

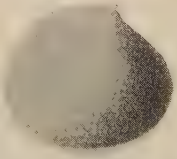

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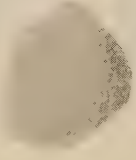

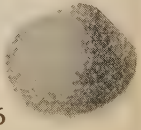

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EXPLANATION OF PLATE 36 (57)

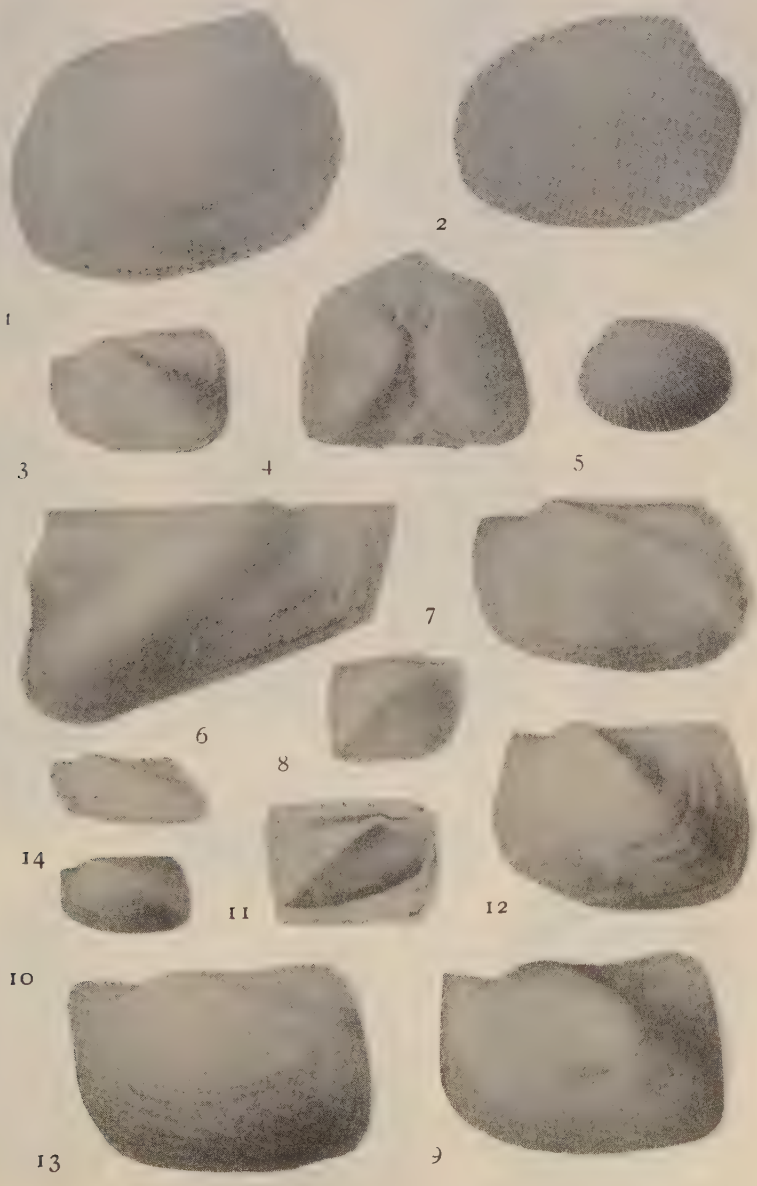
FIGURE

1. **Crenipecten winchelli** Hall. From Pal. of N. Y., v, i, pl. 9, fig. 28. P. 1[illegible].
2. **C. winchelli** Hall. **Ibid. fig. 25.**
3. **C. winchelli** Hall. **Ibid.** fig. 29.
4. **Edmondia phillipi** Hall. Pal. N. Y., v, i, pl. 64, fig. 17. P. 79.
5. **E. phillipi** Hall. **Ibid.**, fig. 12.
6. **E. phillipi** Hall. **Ibid.**, fig. 11.
7. **E. phillipi** Hall. **Ibid.**, fig. 14.
8. **E. phillipi** Hall. **Ibid.**, fig. 9.
9. **Edmondia rhomboidea** Hall. **Ibid.**, fig. 8. P. 79.
10. **Edmondia transversa** Hall. **Ibid.**, fig. 24. P. 79.
11. **Edmondia ? subcarinata** Hall. **Ibid.**, pl. 64, fig. 31. P. 79.
12. **Paracyclas ignota** Hall. **Ibid.**, pl. 72, fig. 34. P. 84.
13. **Paracyclas pauper** Hall. **Ibid.**, pl. 75, fig. 25. P. 85.
14. **P. pauper** Hall. **Ibid.**, fig. 24.
15. **P. pauper** Hall. **Ibid.**, fig. 26.
16. **Nucula globularis** Hall. **Ibid.** pl. 93, fig. 6. P. 74.

EXPLANATION OF PLATE 37 (58)

FIGURE

1. **Pararca sao** Hall. From Pal. of N. Y., v, i, pl. 70, fig. 17. P. 81.
2. **Pararca venusta** Hall. **Ibid.**, pl. 94, fig. 22. P. 80.
3. **Ptychopteria ? obsoleta** Simpson. Tr. Am. Phil. Soc., n. s. 16., 1889, p. 448. P. 70.
4. **Prorhynchus nasutum** Hall. From Pal. of N. Y., pl. 96, fig. 6. P. 62.
5. **Pararca neglecta** Hall. **Ibid.**, pl. 70, fig. 13. P. 80.
6. **Prorhynchus angulatum** Hall. **Ibid.**, pl. 96, fig. 7. P. 60.
7. **Prorhynchus quadratum** Hall. **Ibid.**, pl. 79, fig. 49. P. 59.
8. **P. quadratum** Hall. **Ibid.**, fig. 42.
9. **P. quadratum** Hall. pl. 96, fig. 5.
10. **P. quadratum** Hall. pl. 79, fig. 43.
11. **P. quadratum** Hall. **Ibid.**, fig. 45.
12. **P. quadratum** Hall. **Ibid.**, fig. 48.
13. **P. quadratum** Hall. **Ibid.**, fig. 47.
14. **Leptodesma parallellum** Simpson. Tr. Am. Phil. Soc., n. s. 16, 1889. p. 448. P. 55.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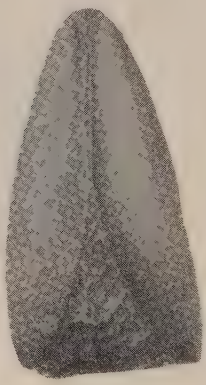
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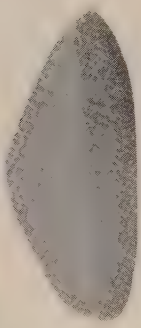
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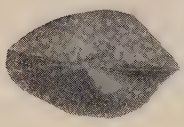
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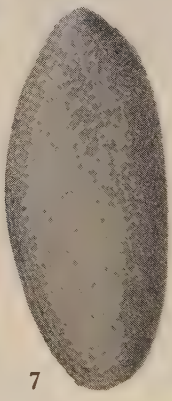
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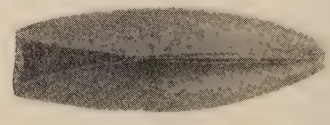
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EXPLANATION OF PLATE 38 (59)

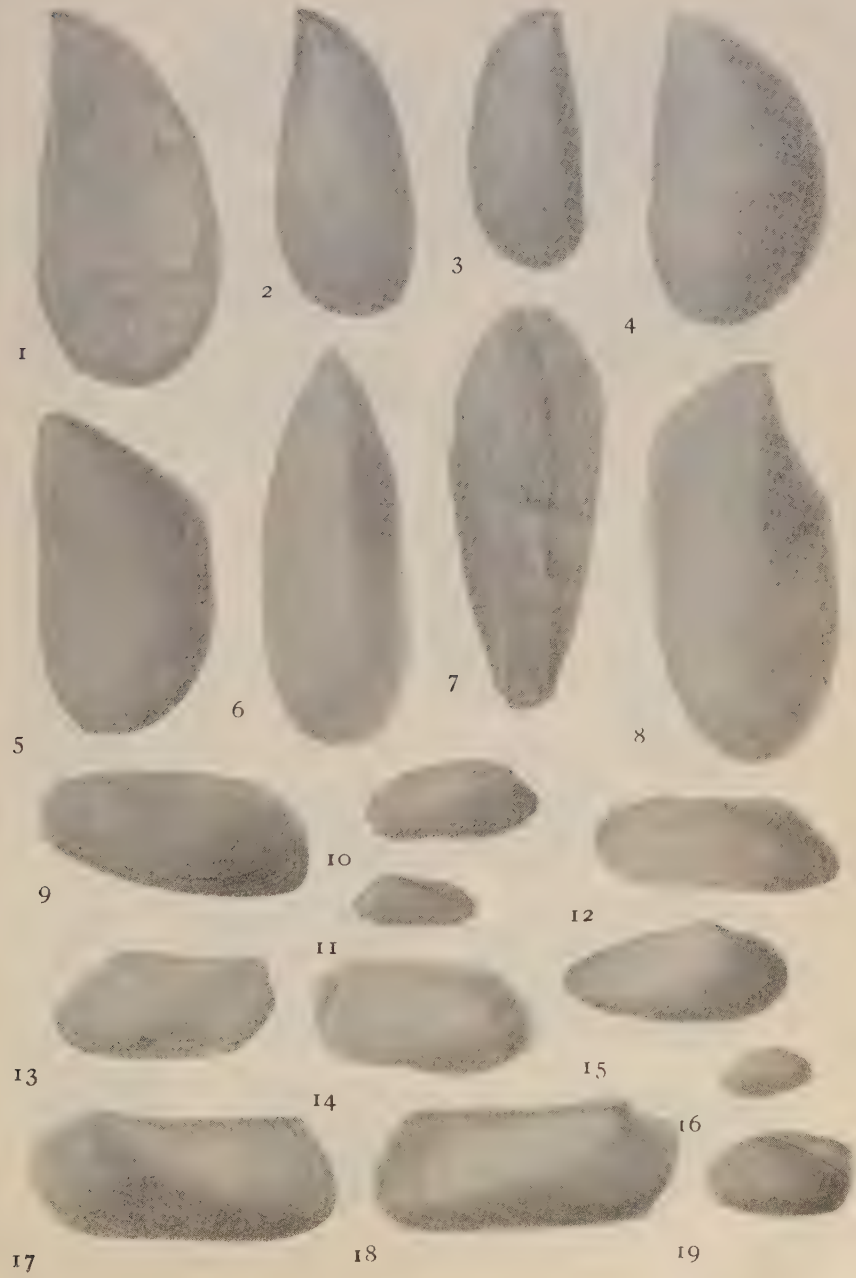
FIGURE

1. **Modiola (Mytilops) præcedens** Hall. From Pal. of N. Y., v, i, pl. 38, fig. 13, P. 72.
2. **M. præcedens** Hall. **Ibid.**, fig. 11.
3. **M. præcedens** Hall. **Ibid.**, fig. 14.
4. **M. præcedens** Hall. **Ibid.**, fig. 17.
5. **M. præcedens** Hall. **Ibid.**, fig. 18.
6. **Mytilarca simplex** Hall. **Ibid.**, pl. 33, fig. 21. P. 22.
7. **Modiola (Mytilops) metella** Hall. **Ibid.**, pl. 87, fig. 9. P. 72.
8. **Mytilarca simplex** Hall. **Ibid.** pl. 33, fig. 11. P. 72.
9. **Modiola (Mytilops) metella** Hall. **Ibid.**, pl. 33, fig. 24.
10. **Mytilarca lata** Hall. **Ibid.**, pl. 33, fig. 22. P. 72.
11. **Modiola (Mytilops) præcedens** Hall. **Ibid.**, pl. 33, fig. 16. P. 72.
12. **M. præcedens** Hall. **Ibid.**, fig. 10.
13. **Mytilarca regularis** Hall. **Ibid.**, pl. 32, fig. 12. P. 71.

EXPLANATION OF PLATE 39 (60)

FIGURE

1. **Mytilarca chemungensis** Hall. From the Pal. of N. Y., v, i, pl. 32, fig. 13. P. 71.
2. **M. chemungensis** Hall. **Ibid.**, fig. 9.
3. **M. chemungensis** Hall. **Ibid.**, fig. 8.
4. **Mytilarca gibbosa** Hall, **Ibid.**, pl. 87, fig. 20. P. 72.
5. **M. gibbosa** Hall. **Ibid.**, fig. 7.
6. **Mytilarca occidentalis** Hall. **Ibid.**, pl. 33, fig. 3. P. 72.
7. **M. occidentalis** Hall. **Ibid.**, fig. 4.
8. **M. occidentalis** Hall. **Ibid.**, fig. 5.
9. **Phthonia truncata** Hall. **Ibid.**, pl. 94, fig. 4. P. 87
10. **Phthonia nitida** Hall. **Ibid.**, fig. 5. P. 87.
11. **P. nitida** Hall. **Ibid.**, fig. 6.
12. **Prothyris exuta** Hall. **Ibid.**, pl. 94, fig. 9. P. 86.
13. **Cypricardinia consimilis** Hall. **Ibid.**, pl. 79, fig. 8. P. 87.
14. **C. consimilis** Hall. **Ibid.**, fig. 19.
15. **Paleoneilo elongata** Hall. **Ibid.**, pl. 48, fig. 39. P. 74.
16. **P. elongata** Hall. **Ibid.**, pl. 93, fig. 11a.
17. **Paleanatina solenoides** Hall. **Ibid.**, pl. 79, fig. 38. P. 88.
18. **P. solenoides** Hall., **Ibid.**, fig. 39.
19. **Paleanatina sinuata** Hall. **Ibid.**, pl. 96, fig. 4. P. 88.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EXPLANATION OF PLATE 40 (61)

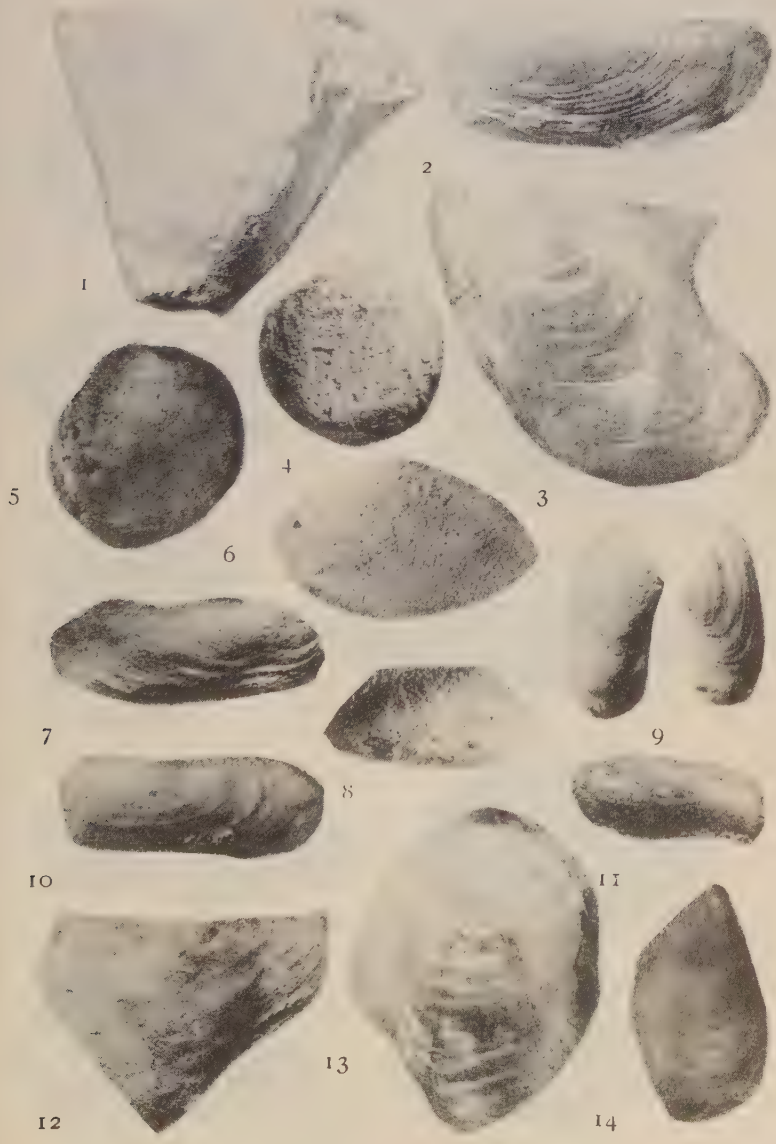
FIGURE

1. **Modiola metella** Hall. From a light brown conglomeritic sandstone at Bradford, Pa. Hinge-line approx. 30 mm. P. 73
2. **Paleanatina, c. typa** Hall. From the faunule with fig. 1. Greatest length 29 mm. P. 87.
3. The right valve of fig. 2.
4. **Nucula cf. globularis** Hall. From a calcareous sandstone in a creek bed one mile east of Stoneham, Pa. Above the 'Sub Olean' conglomerate. Height 14 mm. P. 74.
5. **Mytilarca, cf. occidentalis** Hall. Conewango formation 2 miles north west of Warren, Pa. Total length 34 mm. P. 72.
6. **Paleanatina, cf. typa** Hall. From the faunule with fig. 1, length 30 mm. P. 87.
7. **Modiola præcedens** Hall. From the faunule with fig. 1. Total length 47 mm. P. 72.
8. The right valve of fig. 7.
9. **Leptodesma mytiliforme** Hall. 10 feet above the Roosevelt highway on the north boundary of Smethport, Pa. In a coarse conglomeritic local sandstone. Hinge-line 13.5 mm. P. 43.
10. Right valve of fig. 1.
11. **Nucula** cf. **globularis** Hall. From the Conewango. Height 14 mm. P. 74. Height 14 mm. P. 74.
12. **Paleoneilo, sp.** Upper Conewango at Bradford, Pa. x 19/6.
13. **Paleanatina, c. typa** Hall. From the faunule of fig. 1. Hinge-line 16 mm.
14. Left valve of fig. 13.
15. **Cardinal** view of fig. 13.
16. **Prorhynchus quadratus** Hall. From a light brown quartzitic sandstone 100 feet above the road at Glade, Pa. Height 14 mm. P. 59.
17. **Modiola, sp.** From the faunule of fig. 11. Length 37mm. P. 72.

EXPLANATION OF PLATE 41 (62)

FIGURE

1. **Leptodesma ruedemanni,** n. sp. From a fine grayish sandstone just below the Olean conglomerate at 'Devils Den' south of Smethport, Pa. Nat. size. P. 54.
2. **Leptodesma stephani** Hall. From the upper Chemung beds near Bradford, Pa. Cardinal length 35 mm. P. 46.
3. **Leptodesma potens** Hall. From the Chemung rocks at Panama, N. Y. Hinge-line 33 mm. P. 45.
4. **Edmondia,** sp. From the Salamanca conglomerate at Salamanca Rock city, north of Salamanca, N. Y. Height 18 mm. P. 79.
5. **Schizodus,** sp. In a light brown sandstone 100 feet above the road at Glade, Pa. Height 24 mm.
6. **Nucula,** sp. From the same faunule as fig. 5. Length 28 mm.
7. **Leptodesma stephani** Hall. From the Conewango beds one mile east of Stoneham, Pa. Length 32 mm. P. 46.
8. **Paleanatina,** sp. (?) From the faunule of fig. 4. Length 23 mm.
9. **Grammysia,** sp. Impressions of an external cast. From the Conewango beds at Gowanda, N. Y. Length 22 mm.
10. **Paleanatina angusta** Hall. From a coarse white conglomerate at Portville, N. Y. Length 29 mm. P. 88.
11. **Paleanatina typa** Hall. From the faunule of fig. 10. Length 19 mm., P. 88.
12. **Leptodesma mentor,** var. **maxima** (?) n. var. From the faunule of fig. 1. Hinge-line 38 mm. P. 53.
13. **Anomia** (?) **Archinacella** (?) **incerta** n. sp. From the base of the Conewango formation at Stone Hill near Stoneham, Pa. Height approx. 25 mm. P. 92.
14. **Mytilarca gibbosa** Hall. From above the 'Sub Olean' conglomerate one mile east of Stoneham, Pa. Nat size. P. 72.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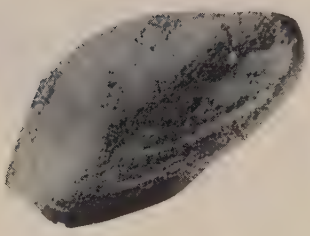

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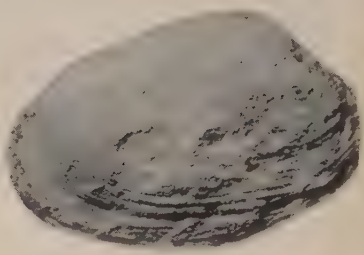

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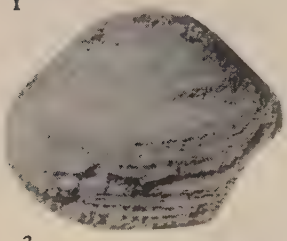

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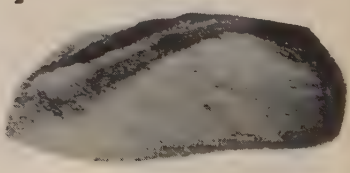

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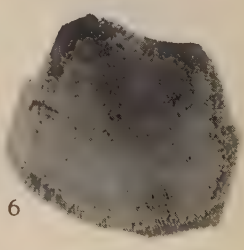

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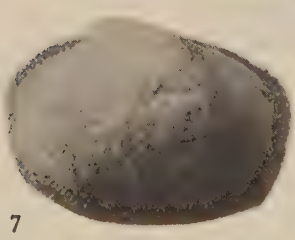

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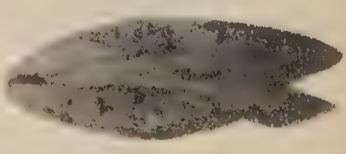

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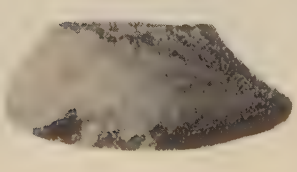

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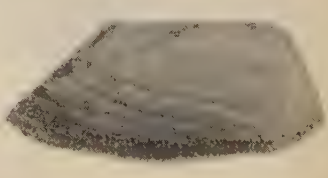

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EXPLANATION OF PLATE 42 (63)

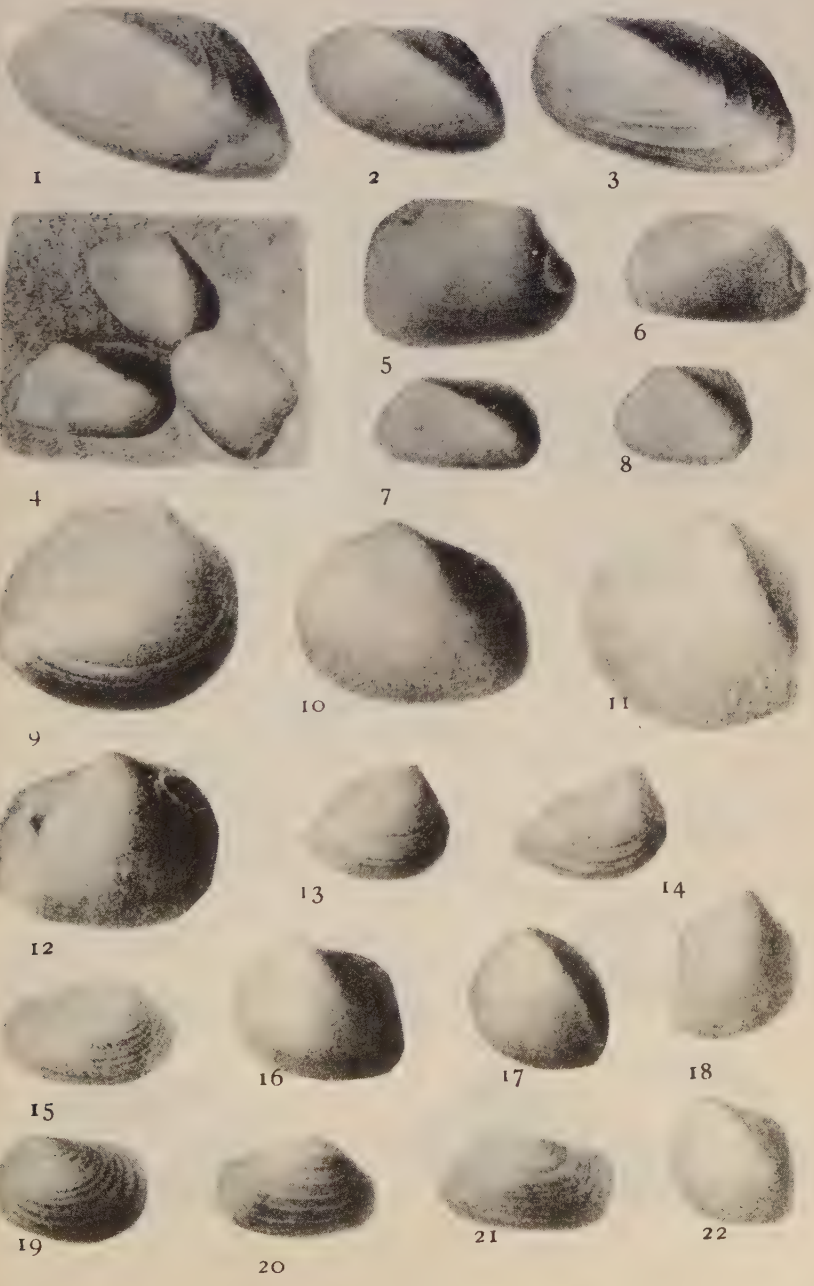
FIGURE

1. **Modiola metella** Hall. In a conglomerate near Bradford, Pa. Hingeline 22 mm. P. 73.
2. **Elymella chadwicki,** n. sp. From the Venango First Oil sand horizon on Stone Hill south east of Stoneham, Pa. Length 41 mm. P. 88.
3. **Pararca equilateralis** n. sp. From a light brown conglomeritic sandstone 100 feet above the road at Glade, Pa. Width 33 mm. P. 84.
4. **contractus** Hall. From the upper Chemung beds, Allegany co., N. Y. Length 35 mm. P. 76.
5. **Sphenotus clavulus** Hall. 4 miles south of Porstville, N. Y., in a coarse brown sandstone. Length 45 mm. P. 76.
6. **Pararca erecta** Hall. From the Panama conglomerate at Panama Rocks, N. Y. Height approx. 21 mm. P. 82.
7. **Pararca transversa** Hall. From the Oswayo strata (Knapps Creek) at Flat Iron Station near Olean Rock City, N. Y. Length 15 mm. P. 83.
8. Cardinal view of fig. 1.
9. **Sphenotus palmeræ,** n. sp. From the light brown sandstone 100 feet above the road at Glade, Pa. x 3/2. P. 77.
10. **Sphentous palmeræ,** n. sp. Right valve of fig. 9.

EXPLANATION OF PLATE 43 (64)

FIGURE

1. **Modiomorpha rigida** Hall. From Pal. of N. Y., v, i, pl. 41, fig. 15. P. 73.
2. **M. rigida** Hall. **Ibid.** fig. 14.
3. **M. rigida** Hall. **Ibid.**, fig. 16.
4. **Modiomorpha quadrula** Hall. **Ibid.**, pl. 41, fig. 23. P. 73.
5. **M. quadrula** Hall. **Ibid.**, fig. 26.
6. **M. quadrula** Hall. **Ibid.**, fig. 21.
7. **M. quadrula** Hall. **Ibid.**, fig. 22.
8. **M. quadrula** Hall. **Ibid.**, fig. 25.
9. **Schizodus chemungensis** var. **quadrularis** Hall. **Ibid.**, pl. 75, fig. 32. P. 85.
10. **Schizodus oblatus** Hall. **Ibid.**, pl. 75, fig. 43. P. 86.
11. **S. chemungensis** var. **quadrularis** Hall. **Ibid.**, fig. 33. P. 85.
12. **Schizodus oblatus** Hall. **Ibid.**, fig. 44.
13. **Schizodus cuneus** Hall. **Ibid.**, fig. 29. P. 86.
14. **S. cuneus** Hall. **Ibid.**, fig. 30.
15. **Sanguinolites (?) undulatus** Hall. **Ibid.**, pl. 64, fig. 1. P. 89.
16. **Schizodus chemungensis**, var. **quadrularis** Hall. **Ibid.**, pl. 75, fig. 31.
17. **Schizodus rhombeus** Hall. **Ibid.**, pl. 75, fig. 20. P. 85.
18. **S. rhombeus** Hall. **Ibid.**, fig. 23.
19. **Sanguinolites undulatus** Hall. **Ibid.**, pl. 64, fig. 2. P. 89.
20. **Sanguinolites subtruncatus** Hall. **Ibid.**, fig. 4. P. 89.
21. **S. subtruncatus** Hall. **Ibid.**, fig. 3.
22. **Schizodus rhombeus** Hall. **Ibid.**, pl. 75, fig. 19. P. 85.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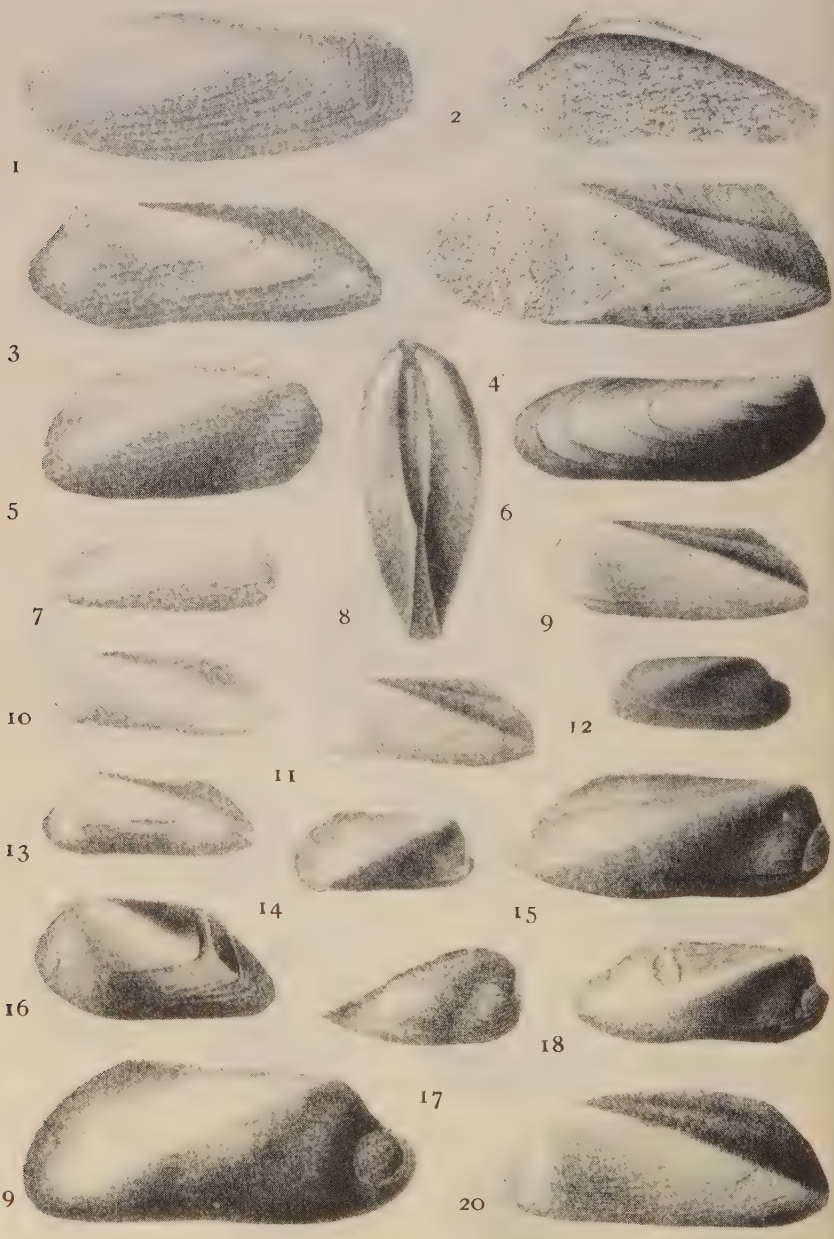
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EXPLANATION OF PLATE 44 (65)

FIGURE

1. **Sphenotus signatus** Hall. From Pal. of N. Y., v, i, pl. 94, fig. 3. P. 77.
2. **Sphenotus contractus** Hall. **Ibid.**, pl. 66, fig. 11. P. 76.
3. **Sphenotus clavulus** Hall. **Ibid.**, fig. 24. P. 76.
4. **S. contractus** Hall. **Ibid.**, pl. 66, fig. 15.
5. **Sphenotus rigidus** Hall. **Ibid.**, pl. 66, fig. 14, from the Chemung.
6. **Sphenotus flavius** Hall. **Ibid.**, fig. 28, from the Chemung.
7. **S. clavulus** Hall. **Ibid.**, fig. 21.
8. **S. flavius** Hall. **Ibid.**, fig. 29.
9. **S. contractus** Hall. **Ibid.**, fig. 4. P. 76.
10. **S. contractus** Hall. **Ibid.**, fig. 2.
11. **S. contractus** Hall. **Ibid.**, fig. 3.
12. **S. contractus** Hall. **Ibid.**, pl. 94, fig. 2.
13. **S. clavulus** Hall. **Ibid.**, pl. 66, fig. 20. P. 76.
14. **S. contractus** Hall. **Ibid.**, fig. 10.
15. **S. contractus** Hall. **Ibid.**, fig. 9.
16. **S. contractus** Hall. **Ibid.**, fig. 17.
17. **S. contractus** Hall. **Ibid.**, pl. 66, fig. 6.
18. **S. contractus** Hall. **Ibid.**, fig. 8.
19. **Sphenotus (?) arcuatus** Hall. **Ibid.**, pl. 66, fig. 18, P. 76.
20. **S. contractus** Hall. **Ibid.**, fig. 13.

EXPLANATION OF PLATE 45 (66)

FIGURE

1. **Paracyclas erecta** Hall. Conewango beds at Glade, Pa. Nat. size. P. 85.
2. **Grammysia duplicata** Hall. From Pal. of N. Y., v, i, pl. 93, fig. 23. P. 75.
3. **Grammysia undata** Hall. **Ibid.**, pl. 61, fig. 23. P. 75.
4. **G. undata** Hall. **Ibid.**, pl. 64, fig. 30.
5. **Grammysia subnasuta** Tall. **Ibid.**, pl. 64, fig. 6. P. 75.
6. **Grammysia glabra** Hall. **Ibid.**, pl. 93, fig. 24. P. 75.
7. **Grammysia communis** Hall. **Ibid.**, pl. 61, fig. 28. P. 75.
8. **G. communis** Hall. **Ibid.**, pl. 61, fig. 26.
9. **G. communis** Hall. **Ibid.**, pl. 61, fig. 25.
10. **G. communis** Hall. **Ibid.**, pl. 61, fig. 24.
11. **Palcanatina angusta** Hall.. **Ibid.**, pl. 79, fig. 32. P. 88.
12. **Paleanatina typa** Hall. **Ibid.**, pl. 79, fig. 26. P. 88.
13. **P. typa** Hall. **Ibid.**, fig. 36.
14. **P. angusta** Hall. **Ibid.**, pl. 79, fig. 30.
15. **P. typa** Hall. **Ibid.**, fig. 28.
16. **P. angusta** Hall. **Ibid.**, fig. 34.
17. **P. angusta** Hall. **Ibid.**, fig. 31.
18. **P. angusta** Hall. **Ibid.**, fig. 33.
19. **P. typa** Hall. **Ibid.**, fig. 37.
20. **P. typa** Hall., **Ibid.**, pl. 79, fig. 37.

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EXPLANATION OF PLATE 46 (67)

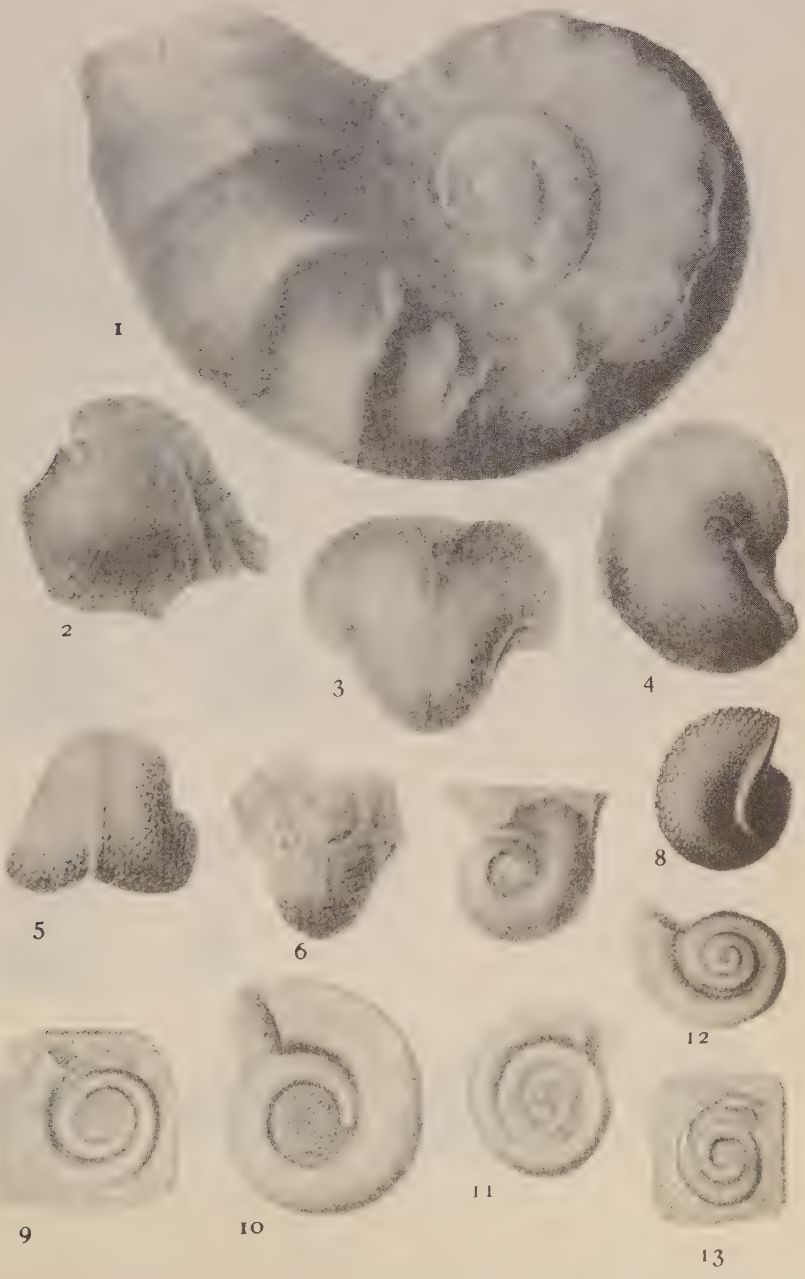
FIGURE

1. **Leptodesma aliforme** Hall. From Pal. of N. Y., v, i, pl. 22, fig. 28.
2. **Pteronites profundus** Hall. **Ibid.**, pl. 22, fig. 27. P. 58.
3. **Pteronites rostratus** Hall. **Ibid.**, fig. 24. P. 58.
4. **Pteronites profundus** Hall. **Ibid.**, fig. 28.
5. **Leptodesma extenuatum** Hall. **Ibid.**, pl. 22, fig. 23.
6. **Pteronites profundus** Hall. **Ibid.**, fig. 25.
7. (?) **Goniophora curvata** Simpson. Tr. Am. Phil. Soc., n. s. 16, 1889, p. 450, fig. 18, P. 78.
8. **Platyceras dorsale** Simp. **Ibid.**, p. 454, fig. 24, no. 2. P. 90.
9. **Platyceras dorsale** Simp. **Ibid.**, fig. 24, no. 1.
10. **Platyceras breve** Simp. **Ibid.**, p. 454, fig. 23, no. 4. P. 90.
11. **Platyceras breve** Simp. **Ibid.**, fig. 23, no. 3.
12. **Platyceras breve** Simp. **Ibid.**, fig. 23, no. 1.
13. **Platyceras breve** Simp. **Ibid.**, fig. 23, no. 2.
14. **Platyceras striatum** Simpson. **Ibid.**, p. 457, fig. 27, no. 1. P. 90.
15. **Platyceras striatum** Simp. **Ibid.**, fig. 27, no. 2.
16. **Platyceras inæquale** Simp. **Ibid.**, p. 456, fig. 25, no. 2. P. 90.
17. **Platyceras inæquale** Simp. **Ibid.**, fig. 25, no. 1.
18. **Platyceras inæquale** Simp. **Ibid.**, fig. 25, no. 3.
19. **Platyceras mitelliforme** Simp. **Ibid.**, p. 456 ,fig. 26, no. 1. P. 90.
20. **Platyceras mitelliforme** Simp. **Ibid.**, fig. 26, no. 2.
21. **Platyceras varians** Simp. **Ibid.**, p. 458, fig. 28. P. 90.

EXPLANATION OF PLATE 47 (68)

FIGURE

1. **Gyroceras stebos** Hall. From Pal. of N. Y., vii, pl. 125, fig. 7. P. 94.
2. **Bellerophon leda** Hall. From Pal. of N. Y., v, ii, pl. 26, fig. 24, a Hamilton form, for comparison.
3. **Bellerophon maera** Hall. **Ibid.**, pl. 26, fig. 19. P. 89.
4. **B. maera** Hall. **Ibid.**, fig. 21.
5. **B. maera** Hall. **Ibid.**, pl. 25, fig. 12.
6. **B. maera** Hall. **Ibid.**, pl. 26, fig. 20.
7. **B. maera** Hall. **Ibid.**, fig. 22.
8. **B. maera** Hall. **Ibid.**, fig. 13.
9. **Euomphalus hecale** Hall. **Ibid.**, pl. 16, fig. 13. P. 90.
10. **E. hecale** Hall. **Ibid.**, fig. 10.
11. **E. hecale** Hall. **Ibid.**, fig. 14.
12. **E. hecale** Hall. **Ibid.**, fig. 12.
13. **E. hecale** Hall. **Ibid.**, fig. 11.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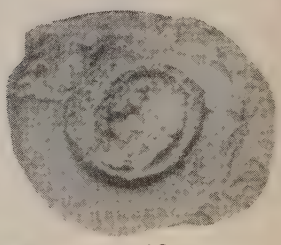
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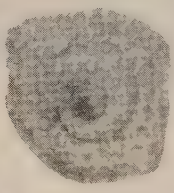
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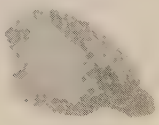
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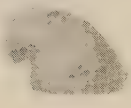
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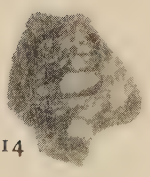
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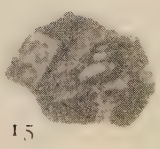
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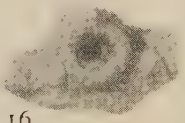
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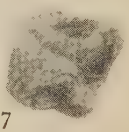
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EXPLANATION OF PLATE 48 (69)

FIGURE

1, 2, 13. **Euomphalus hecale** Hall. From the Panama conglomerate at Panama Rocks near the Checkered School House, Chautauqua co., N. Y. Nat. size. P. 90.

3. **Pleurotomaria**, sp. Venango First Oil sand horizon on Stone Hill near Stoneham, Pa. Height 7 mm. P. 92.

4, 5. **Platyceras ruedemanni**, n. sp. 1½ mile east of Glade, Pa., in a chocolate colored sandstone (weathered limy sandstone) which is at the Oswayo horizon. Nat. size. P. 91.

6. **Bellerophon**, sp. From the Conewango formation at Glade, Pa. Nat. size.

7. **Platyceras**, sp. A warped internal mould from the Venango First Oil sand horizon just east of the Cobham monument. Nat size.

8, 9. **Platyceras**, sp. From the same faunule as fig. 7. Nat. size.

10. **Pleurotomaria**, sp. From the same faunule as fig. 3. Nat size.

11. **Platyceras**, sp. From the faunule of fig. 3. Nat size.

12. **Pleurotomaria**, sp. External cast. From the faunule of fig. 7.

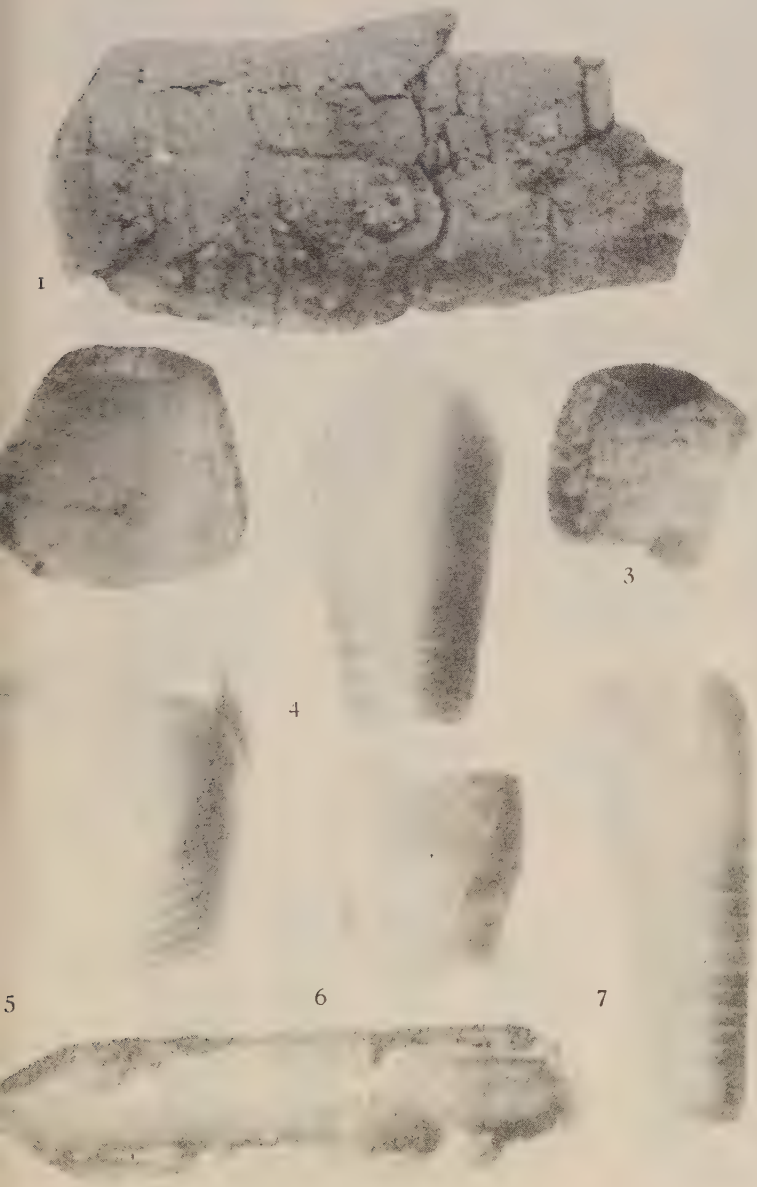
14, 15. **Pleurotomaria**, sp. From the faunule of fig. 3.

16, 17. **Bellerophon ?**, sp. From the faunule of fig. 7. Slightly enlarged.

EXPLANATION OF PLATE 49 (70)

FIGURE

1. **Orthoceras, sp.** From the highest conglomerate on the top of Robins Hill, about one mile east of the Chautauqua-Cattaraugus county line, N. Y. P. 93.
2. **Orthoceras, sp.** A cast of a septum of fig. 1.
3. **Gomphoceras, sp.** From the light brown sandstone 100 feet above the road at Glade, Pa., P. 94.
4. **Cyrtoceras hector** Hall. From Pal. of N. Y., v, ii, pl. 90, fig. 14. P. 94.
5. **Cyrtoceras hector, Hall. Ibid., fig. 11.**
6. **Gomphoceras nasutum** Hall. **Ibid.,** vol. vii, pl. 120, fig. 5. P. 94.
7. **Orthecras, sp.** From the horizon of the Venango First Oil sand one mile east of Stoneham, Pa., P. 93.
8. **Orthoceras leander** Hall. From Pal. of N. Y., v, ii, pl. 90, fig. 7. P. 93.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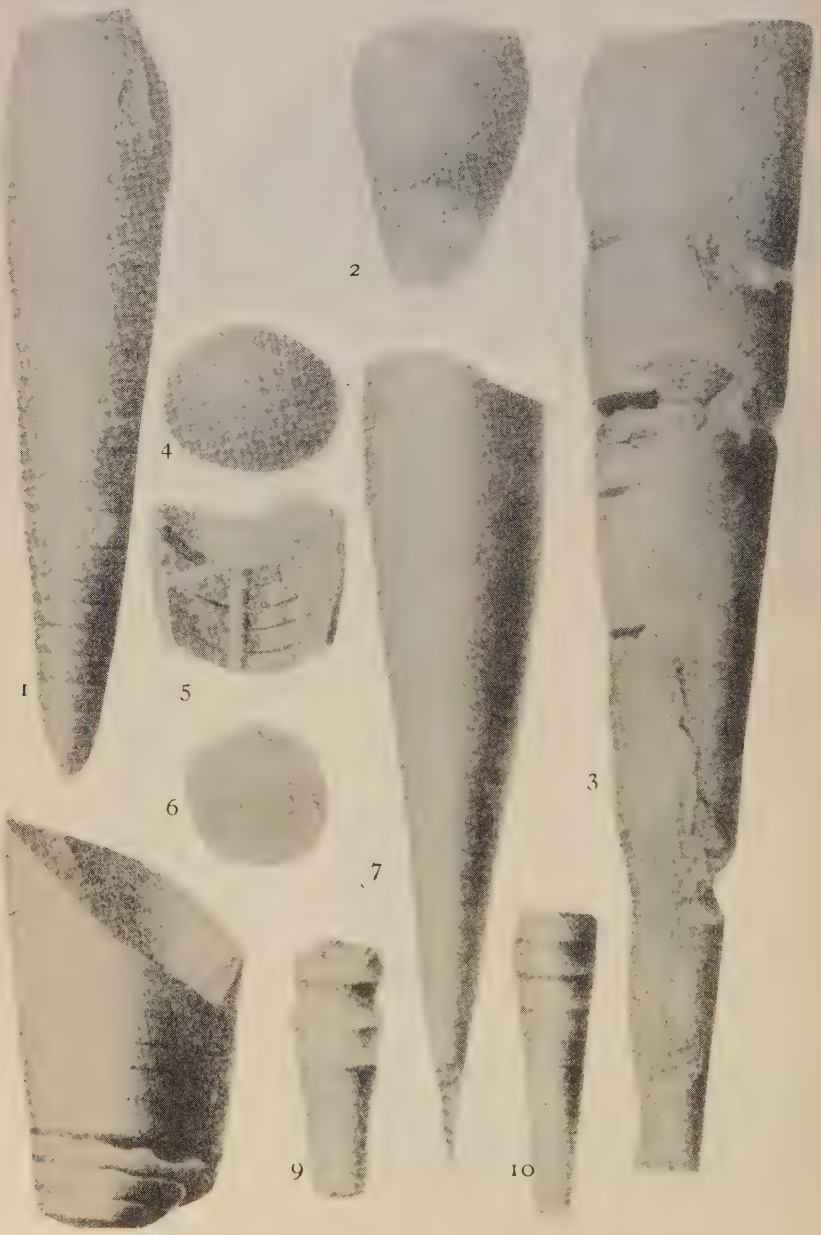
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EXPLANATION OF PLATE 50 (71)

FIGURE

1. **Orthoceras leander** Hall. From Pal. of N. Y., v, ii, pl. 90, fig. 8. P. 93.
2. **Gomphoceras tumidum** Hall. **Ibid.**, pl. 95, fig. 5, P. 94.
3. **Orthoceras consortale** Hall. **Ibid.**, Supp. to vii, pl. 118, fig. 3, x approx. 5/6 Hall's illustration. P. 93.
4. **Orthoceras consortale Ibid.**, fig. 5. Same reduction.
5. **Orthoceras consortale** Hall. **Ibid.**, fig. 4.
6. **Gomphoceras nasutum** Hall. (See plate 49) Transverse view showing the position of the siphuncle. **Ibid.**, Supp. to vii, pl. 120, fig. 7, P. 94.
7. **Orthoceras warrenense** Miller, (**O. cochleatum** Hall). From Pal. of N. Y., v, ii, pl. 113, fig. 19, P. 93.
8. **Cyrtoceras hector** Hall. **Ibid.**, pl. 92, fig. 12, P. 94.
9. **Orthoceras bipartitum** Hall. **Ibid.**, pl. 113, fig. 20, P. 93.
10. **O. bipartitum** Hall. **Ibid.**, fig. 21.

EXPLANATION OF PLATE 51 (72)

FIGURE

1. **Thysanodictya expansa** Hall. From Rep. N. Y. S. Geol., 1896, pl. 53, fig. 3. x 1/2 Hall's figure. P. 96.
2. **Hydnoceras nodosum** Hall. **Ibid.**, pl. 2, fig. 2. Nat size. P. 95.
3. **Tylodictya ? tenuis** Hall. **Ibid.**, pl. 53, fig. 5, Nat. size. P. 96.
4. **Thysanodictya randalli** Hall. **Ibid.**, pl. 24, fig. 12, x 6/7 Hall's fig. P. 96.
5. **Ectenodictya implexa** Hall. **Ibid.**, pl. 54, fig. 4. Nat. size. P. 97.

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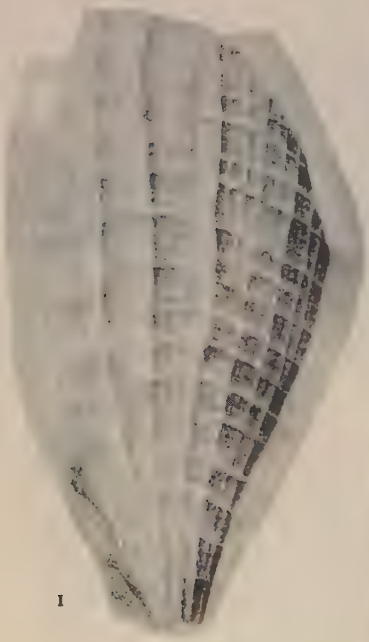

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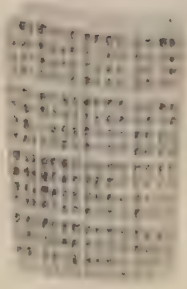

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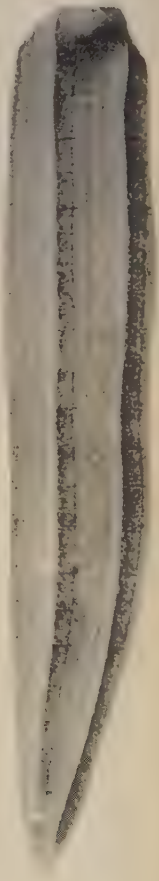

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EXPLANATION OF PLATE 52 (73)

FIGURE

1. **Clathrospongia abacus** Hall. From the Rep. of the N. Y. S. Geol., for 1896, pl. 49, fig. 5. x 17/20 Hall's fig. P, 96.
2. **C. abacus** Hall. **Ibid.**, fig. 6. Nat. size. P. 96.
3. **Clathrospongia abacus** Hall. **Ibid.** fig. 6 Nat. size. P. 96.
4. **Prismodictya conradi** Hall. **Ibid.**, pl. 19, fig. 6. x 11/13 Hall's fig., P. 95.
5. **Calathospongia carli** Hall. **Ibid.**, pl. 52, fig. 6. x 13/17 Hall's fig., P. 96.
6. **Clathrospongia abacus Hall.**, pl. 49, fig. 8. Nat. size, P. 96.

EXPLANATION OF PLATE 53 (74)

FIGURE

1. **Calathospongia redfieldi** Hall. From the Rep. of the N. Y. S. Geol., 1896, pl. 49, fig. 2. x 17/40 Hall's fig. P. 96.
2. **C. redfieldi** Hall. **Ibid.**, fig. 4. x 5/6 Hall's fig.
3. **Prismodictya choanea** Hall. **Ibid.**,., pl. 19, fig. 1. x 17/24 Hall's fig. P. 95.
4. **Tylodictya warrenensis** Hall. **Ibid.**, p. 343 text fig. x 7/8 Hall's fig. P. 96.
5. **Prismodictya allegania** Hall. **Ibid.**, pl. 20, fig. 4. x 8/25 Hall's fig. P. 95.
6. **Prismodictya prismatica** Hall. **Ibid.**, pl. 21, fig. 6. x 8/9 Hall's fig. P. 95.

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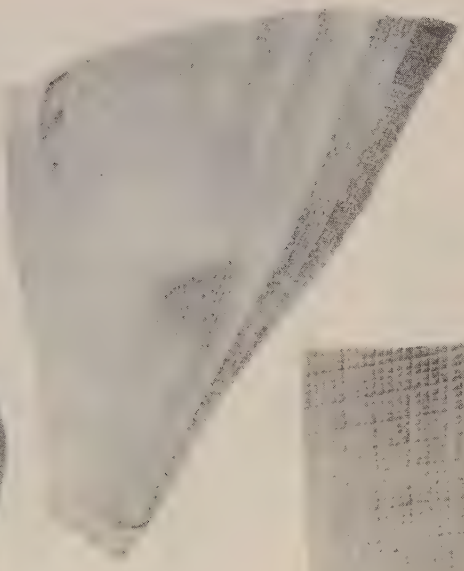

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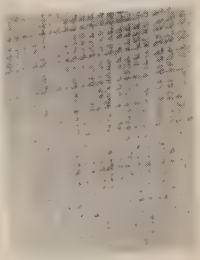

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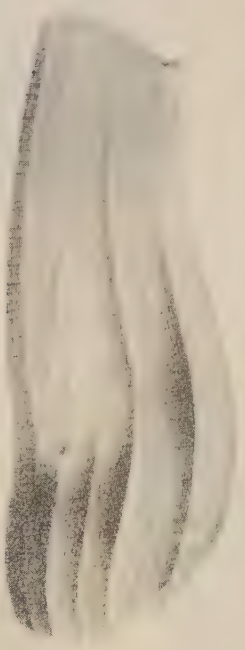

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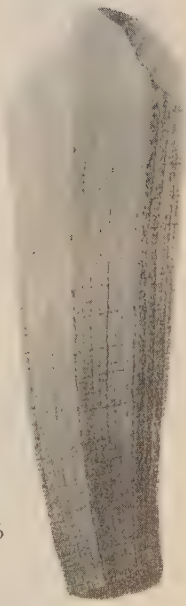

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EXPLANATION OF PLATE 54 (75)

FIGURE

1. **Tropidocaris bicarinata** Beecher. From Geol. Journ. 58, 1902, pl. 19, fig. 2. P. 97.
2. **Elymocaris siliqua** Beecher. Ibid., pl. 19, fig. 8. P. 98.
3. **Tropidocaris bicarinata** Beecher. Ibid., fig. 6.
4. **Tropidocaris bicarinata** Beecher. Ibid., fig. 3.
5. **Echinocaris clarkii** Beecher. Ibid., pl. 18, fig. 9. P. 97.
6. **Tropidocaris bicarinata** Beecher. Ibid., pl. 19, fig. 4.
7. **Tropidocaris bicarinata** Beecher. Ibid., fig. 1.
8. **Elymocaris siliqua** Beecher. Ibid., pl. 19, fig. 7.
9. **Tropidocaris bicarinata** Beecher. Ibid., fig. 5.
10. **Tropidocaris bicarinata** Beecher. From the Pal. of N. Y., vii, pl. 31, fig. 12.

EXPLANATION OF PLATE 55 (76)

FIGURE

1. **Protolimulus eriensis** (Wms) From Hall, Pal. of N. Y., vii, pl. 27, fig. 1, P. 99.
2. **Protolimulus eriensis** (Wms) From the green shales at the ceramic quarry at Lewis Run near Bradford, Pa.
3. **Stylonurus beecheri** (Hall) From Pal. of N. Y., vii, pl. 27, fig. 5, P. 98.
4. **Echinocaris socialis** Beecher. From the Geol. Journ., 118, fig. 1, P. 97.
5. **Echinocaris randalli** Beecher. **Ibid.**, pl. 18, fig. 8, P. 97.
6. **Echinocaris socialis** Beecher. **Ibid.**, fig. 4.
7. **Echinocaris socialis** Beecher. **Ibid.**, fig. 3.
8. **Echinocaris socialis** Beecher. **Ibid.**, fig. 2.

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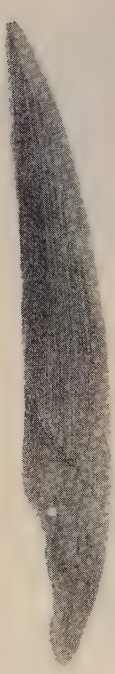

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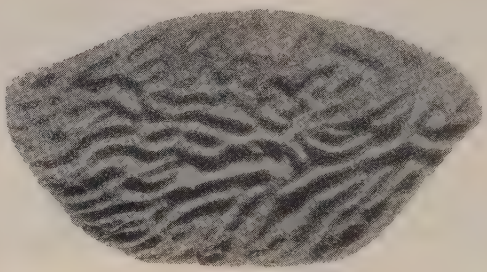

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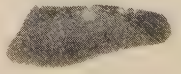

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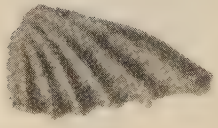

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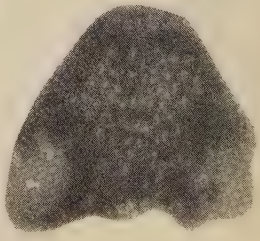

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EXPLANATION OF PLATE 56 (77)

FIGURE

1. **Ctenacanthus triangularis** Newb. From Pal. of Ohio, Impl., 36, fig. 1, P. 102.
2. **C. triangularis Ibid.**, fig. 1a.
3. **Holonema rugosa** Claypole. From below the second conglomerate at Bradford, Pa., P. 104.
4. **Holoptychus americanus** Leidy. From Mon. U. S. G. S. No. 16, pl. 19, fig. 13. P. 104.
5. **Dinichthys tuberculatus** Newb. **Ibid.**, pl. 37, fig. 3, P. 104.
6. **Ganorhynchus beecheri** Newb. **Ibid.**, pl. 19, fig. 2. P. 105.
7. **Dipterus nelsoni** Newb. From Dev. Fishes of N. Y., pl. 4, fig. 15, P. 105.
8. **D. nelson** Newb. **Ibid.**, fig. 14.
9. **Ctenacanthus chemungensis** East. **Ibid.**, pl. 7, fig 3, P. 102.
10. **Holoptychus pustulosus** Newb. Mon. U. S. G. S., No. 16, pl. 20, fig. 11. P. 104.

EXPLANATION OF PLATE 57 (78)

FIGURE

1. **Ctenacanthus harrisi** n. sp. From the Oswayo sandstone east of Mt. Jewitt, Pa. Nat. size. approx. P. 103.
2. **Holoptychus taylori** (Hall)? From the Chemung beds at Bradford, Pa. Greatest width 38 mm. P. 104.
3. **Rhadinichthys** sp. nov. East. From the Dev. Fishes of N. Y., pl .19, fig. 4. P. 105.
4. **Bothriolepis minor** Newb. From Mon. U. S. G. S., No. 16, pl. 20, fig. 7. P. 106.
5. **Holoptychus americanus** Leidy. **Ibid.**, pl., 19, fig. 12, P. 104.
6. **Rhadinichthys,** sp. nov. East. (See fig. 3), pl. 4, fig. 11. P. 105.

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EXPLANATION OF PLATE 58 (79)

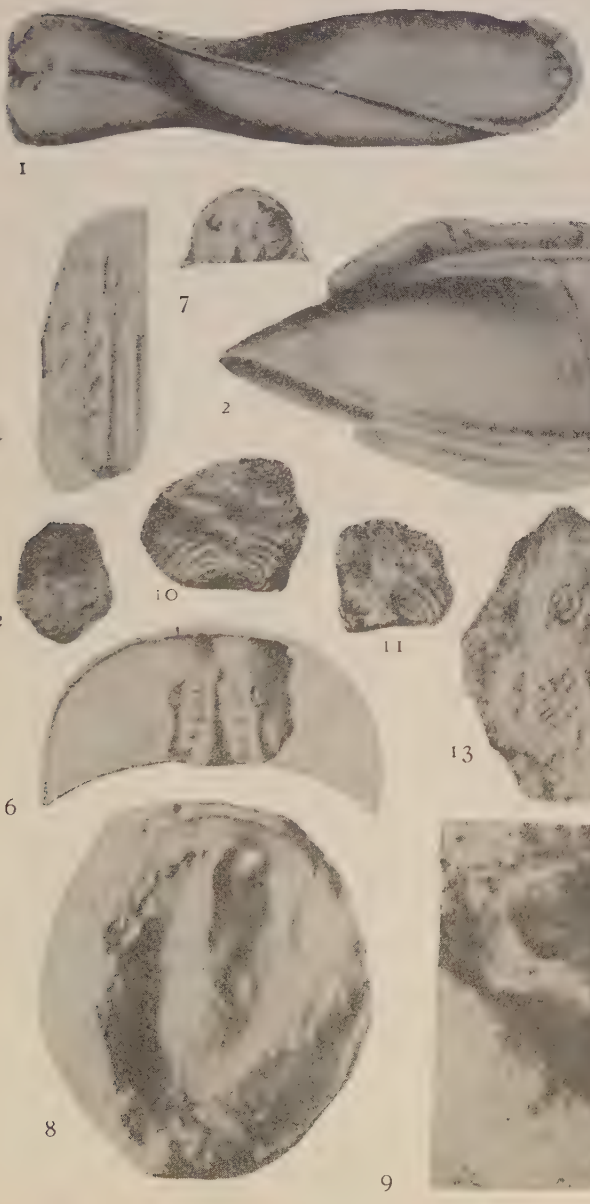
FIGURE

1. **Dipterus (Ctenodus) nelsoni** Newb. Mon. U. S. G. S., No. 16, pl. 27, fig. 19. P. 105.
2. **Dipterus Ctenodus levis** Newb. **Ibid.**, pl., 27, fig. 22. P. 105.
2. **Dipterus (Ctenodus) levis** Newb. **Ibid.**, pl. 27, fig. 22. P. 105.
3. **Homacanthus acinaciformis** East. From Dev. Fishes of N. Y., pl. 1, fig. 16. P. 106.
4. **Apedodus priscus** Leidy. **Ibid.**, pl. 1, fig. 1. P. 106.
6. **Gyracanthus sherwoodi** Newb. From Mon. U. S. G. S., No. 16, pl. 18, fig. 4. P. 106.
7. **Gyracanthus sherwoodi** Newb. **Ibid.**, fig. 4a.
8. **Gyracanthus sherwoodi** Newb. From Dev. Fishes of N. Y., pl. 3, fig. 7.
9. **Dipterus (Ctenodus) levis** Newb. Mon. U. S. G. S., No. 16, pl. 27, fig. 23.
10. **Dipterus (Ctenodus) flabelliformis** Newb. **Ibid.**, pl. 27, fig. 21. P. 105.
11. **Dipterus (Ctenodus) nelsoni** Newb. **Ibid.**, fig. 20. P. 105.
12. **Sagenodus** sp. From Dev. Fishes of N. Y., pl. 1, fig. 13. P. 106.
13. **Dipterus (Ctenodus) quadratus** Newb. Mon. U. S. G. S., No. 16, pl. 27, fig. 24. P. 105.
14. **Dipterus (Ctenodus) quadratus** Newb. **Ibid.**, fig. 25.
15. **Dipterus (Ctenodus) minutus** Newb. **Ibid.**, pl. 27, fig. 26. P. 105.
16. **Dipterus (Ctenodus) flabeiliformis** Newb. **Ibid.**, fig. 21a.

EXPLANATION OF PLATE 59 (80)

FIGURE

1. **Spirodomus insignis** Beecher. From 39th Rep. N. Y. S. Mus Nat. Hist., pl. 12, fig. 4. P. 82.
2. **Spirodomus insignis** Beecher. **Ibid.**, fig. 5. P. 97.
3. **Tropidocaris interrupta** Beecher. From Pal. of N. Y., vii, pl. 31, ng. 13. P. 97.
4. **Tropidocaris alternata** Beecher. **Ibid.**, fig. 15. P. 97.
5. **Tropidocaris alternata** Beecher. **Ibid.**, fig. 14.
6. **Prestwichia randalli** Beecher. From Amer. Geol., 29, 1902, p. 143. P. 98.
7. **Eurypterus pennsylvanicus** C. E. Hall. 2nd. Pa. Geol. Surv. Rep. pl. 5, fig. 18. P. 98.
8. **Thinopus antiquus** Marsh. From Morton, D. J. Am. Journ. of Sc., n. s. 71, no. 12, 1927, p. 409. P. 107.
9. **Thinopus antiquus** Marsh. **Ibid**.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